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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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Additional inventors are being named on the 1 *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

A Method and Mechanisms for Efficient, Scalable, and Reliable Delivery of Interactive Program Data

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ENCLOSED APPLICATION PARTS *(check all that apply)*

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METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.
☑ A check or money order is enclosed to cover the filing fees.
☑ The Director is herby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 50-1610
☐ Payment by credit card. Form PTO-2038 is attached.

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.
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Respectfully submitted,

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Date November 13, 2003

REGISTRATION NO. 40,872 *(if appropriate)*

Docket Number: NCBE-03400

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Additional Pag

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INVENTOR(S)/APPLICANT(S)

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Number 2 of 2

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A METHOD AND MECHANISMS FOR EFFICIENT, SCALABLE, AND RELIABLE DELIVERY OF INTERACTIVE PROGRAM DATA

BACKGROUND:

Several problems must be solved to efficiently deliver scalable and reliable interactive program data for the purposes of VOD:

- Subscriber account data must be stored, maintained, and delivered across the network
- Movie metadata (titles, prices, ratings, etc.) must be stored, maintained, and delivered across the cable network
- Movie metadata must be packaged to make efficient use of cable plant bandwidth and set top box memory.
- Video sessions must be maintained in a reliable way.
- Finally, using the infrastructure outlined above some or all of the following VOD applications are provided: Subscription video on demand (SVOD), advertising, previews, network personal video recorder (NPVR), and VOD Barker channels must be provided using the above mechanisms.

DESCRIPTION OF THE INVENTION:

SUMMARY

Our solution is a generic delivery system and method for providing reliable, scalable, and flexible video on demand in a cable network environment. The system consists of two subsystems; a broadcast data delivery system, and a point cast data delivery system. Configuration data for individual set-top boxes is sent over the cable plant such that different groups of set top boxes *(service groups)* share configurations. Movie metadata (movie title, price, etc.) can be broadcast to all set top boxes in the system, or *narrow cast* to these same service groups.

The initial solution required component development for a Motorola-based video on demand system. The individual components are separate instruments specific to a video on demand architecture. For Motorola systems, these include movie metadata carousels (MMCs), trigger carousels, initialization carousels, up and downstream heartbeat mechanisms, and cover streams.

METADATA

The metadata and configuration data is encoded into mpeg-2 transport streams using private data PIDs to contain the application data. These transport streams, or Movie Metadata Carousels (MMCs) contain one private data PID per movie genre (figure 1). The data is packaged using an algorithm that ensures reliable and efficient delivery of the data to the set-top boxes (figure 2). This software algorithm packages the metadata into appropriately sized and arranged packets so as to be quickly and efficiently broadcast through the cable plant and ingested and stored on the cable set top boxes. As the user browses the metadata stored on the set top box, an algorithm determines when it is necessary to delete and replace currently stored metadata with new metadata. This method of using the broadcast network as a data store ensures that the client has access to large volume of metadata. For example, less frequently accessed metadata is packaged

separately from more-frequently used metadata. The user's browsing experience is made faster by caching more frequently used metadata on the set-top box.

INITIALIZATION CAROUSEL

The initialization carousel is a separate carousel used to carry initialization and configuration data to the set top box. These streams exist one per service group such that different configuration data can be conveyed on a per-service group basis. The structure is the same as MMC.

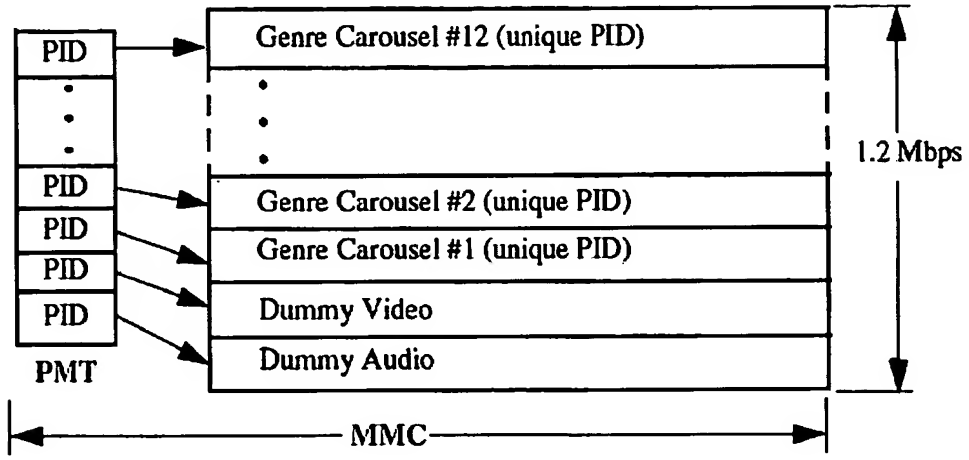


Figure 1

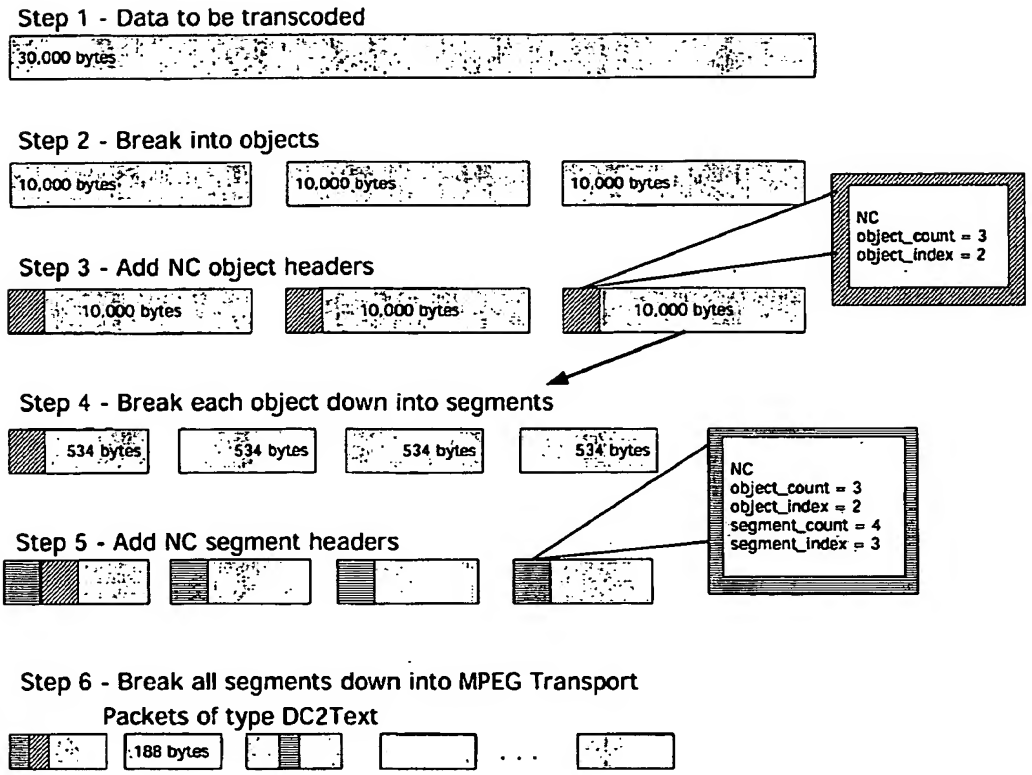


Figure 2

When metadata or configuration data changes the new data streams are established alongside the old streams. Once the new set is available and has been acquired, the data switching transaction is complete. If an error occurs while switching data, the old data remains available. Changing metadata is this transacted fashion ensures reliability.

SUBSCRIBER DATA

Along with metadata which is broadcast on the cable plant, subscriber-specific data is sent to set top boxes only as it is requested. Again, the data is packaged to ensure quick access to more frequently used data. The set top box uses an algorithm to determine when to use data stored locally on the set top box, and when to request new data from the server.

UPSTREAM AND DOWNSTREAM HEARTBEAT

The movie metadata allows the user to browse movie titles and choose a movie to watch. Motorola set top boxes have no means to detect an on-demand video stream and/or loss of on-demand video stream. To solve this problem each mpeg-2 video file contains embedded control data packets, or heart-beat packets which are added when the video file is registered with on the system. When these files are streamed, these embedded packets are received and decoded by the set top box while the user views the movie. nCUBE software running on the set top box uses the heart-beat packets to indicate that video is successfully streaming. If the heart-beat data packets are not detected, the set top box gracefully exits the video session (figure 3).

Similar hart-beat packets also flow upstream from the set top box to the video server. These packets are sent over the Out Of Band network using the RTSP protocol. The video server receives and decodes these packets as an indication that video is successfully being viewed on the set top box. If the video server stops receiving the upstream heart-beat packets, the video server gracefully exits the video session (figure 3).

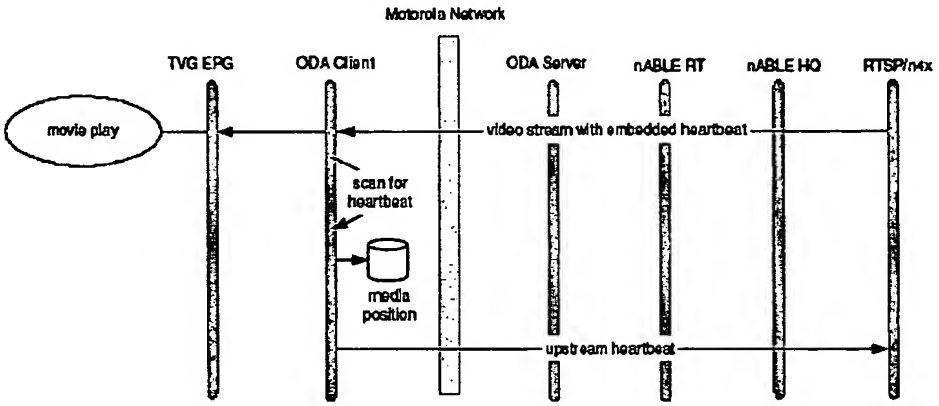


Figure 3

COVER STREAM

When this solution is deployed in a Motorola environment a certain limitation must be overcome on Motorola DCT 2000 set top boxes. The tuner on the DCT 2000 set-top box requires a ratio of payload to null data within the QAM. The DCT 2000 firmware cannot tune a low-bitrate DC2TEXT stream unless there is other payload data within the QAM.

nCUBE implements a *cover stream* mechanism that fulfills the payload requirement and enables the set-top to tune low-bitrate data carousels. This cover stream is essentially an MPEG-2 black video stream encoded at 2.0 Mbps to meet the payload to null data ratio requirement.

For the ODA 2.3 release, the cover stream mechanism is dynamically allocated on the QAM as required. In other words, the cover stream is inserted into the QAM when no other MPEG video is playing. When other MPEG video is present, the cover stream is removed. By dynamically allocating the cover stream, the full bandwidth of the QAM is available for streaming video. Although the cover stream is necessary only if the QAM contains an initialization carousel, for design simplicity a cover stream is inserted into every narrowcast QAM.

APPLICATIONS

The infrastructure described above provides a platform on which VOD applications can be deployed. Some examples of these applications are:

SUBSCRIPTION VOD

Subscription video on demand allows users to be entitled to a group of assets for which they are billed on a reoccurring basis. Using the metadata mechanism described above, subscription data

is packaged and delivered to the client. Subscription data includes price, title, description, contract window, and a list of associated assets.

ADS and BARKERS

Some VOD clients allow the association of moving video with VOD guide data. Our metadata model associates a virtual channel number with each category such that capable clients may tune and display video along with the VOD asset data. The metadata also allows for transporting still image data so that capable clients may display still images within the VOD guide. For example, this can be used to display advertisements or movie box cover images.

The video on demand solution described herein is meant to be flexible to environment and requirement changes. The movie metadata delivery mechanism applies to any type, or size of application private data (e.g. the mechanism accommodates sending data in multiple languages who's character set can be encoded in 8-bit ASCII). Likewise, the subscriber data mechanism can accommodate additions and deletions of subscriber account parameters. A goal of the solution is to adapt easily to different video on demand environments (see figure 4). Finally, this mechanism is meant to accommodate different volumes of movie and subscriber data by varying the number of PIDs within an MMC, and the number of MMC within the cable network. Also, the bandwidth of the MMCs can be varied (within acceptable limits) to increase or decrease the rate at which data is received and decoded by the set top boxes.

It will be apparent that aspects of the invention may be used with other electronic devices and consumer electronic devices such as PDA's, smart TVs, cell phones and other devices that receive information from another device and/or that present graphics or text to a user. For example, aspects of a carousel and method of use as described herein may be used to repeatedly transmit information from a location to devices at other locations that might eventually need at least a portion of information, without the devices having to specifically request the information. Such a technique may be used advantageously to reduce interactive bandwidth. This may enhance the appearance of interactivity, without the use of significant interactive bandwidth.

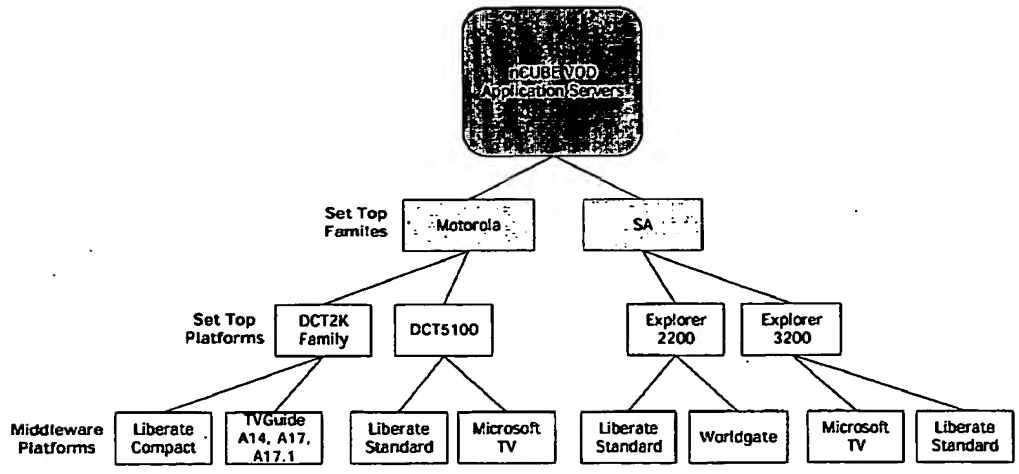


Figure 4

Producing the Stream

Below are the steps the transcoder takes to packetize and arrange the data in the carousel transport stream :

- Receive metadata from nABLE and store in ODA A17 data structures
- Break the structures down into objects
- Break the objects down into segments (currently 534 bytes)
- Interleave the segments in a round-robin fashion.
- Create PAT and PMT entries for the stream based on the number of PIDs.
- Wrap each A17 segment with a MPEG DC2 message type for the appropriate type and PID.
- Segment the MPEG DC2 packets into basic 188 byte MPEG packets.
- Interleave the MPEG packets in a round-robin fashion.
- Interleave the MPEG packets with PSI packets based on the predetermined frequency.
- Write the MPEG+PSI packets to the stream.

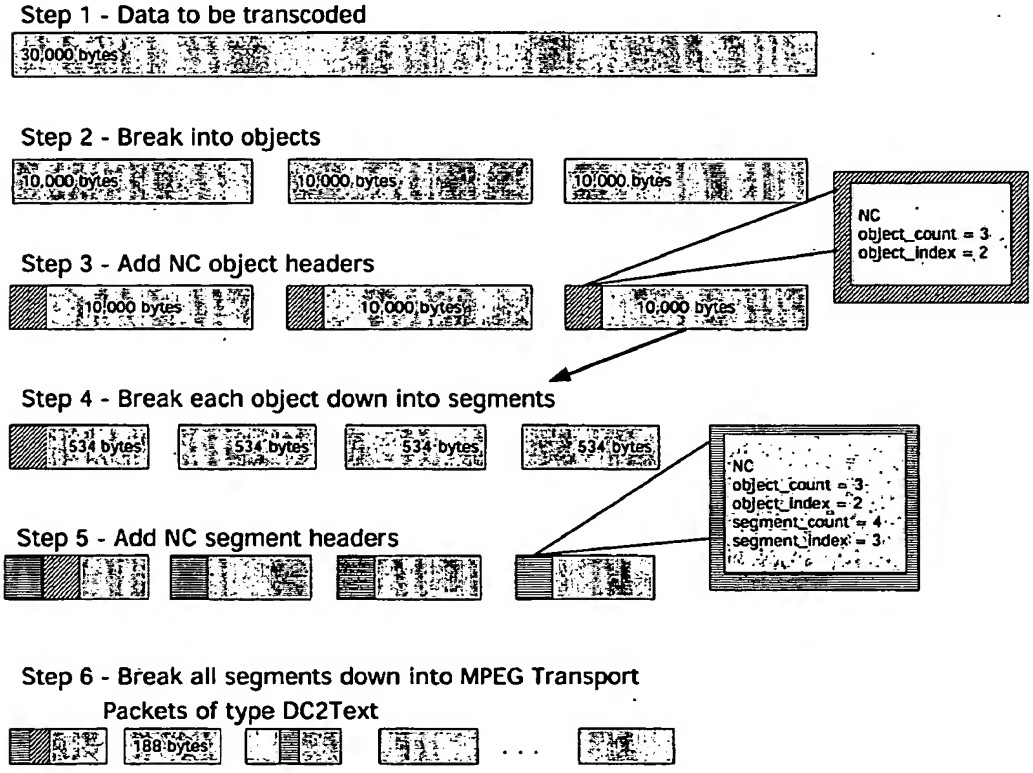


Figure 5 - transcoding step by step

Explanation of Figure 5

Step 1 – We start with the data to be transcoded. This could be Asset_Index data, Category_Index data, Package_Index, data, etc.

Step 2 – The data is broken down into a collection of objects. The default settop client cache size is 20,000 bytes. The transcoder will size the objects of different types accordingly based on the type of the object.

Object Sizes and Limitations			
Object Type	Number of Entries	Total Size of Object	Description
CATEGORY_INDEX	1-150		
PACKAGE_INDEX	1-5		
ASSET_INDEX and CATEGORY_ASSET	1-100		Asset index data and category asset data are always cached together. This formula calculates the number of assets_index records and category_asset records we can cache once we have already cached the category_index data (which needs to be cached at all times). The result is 34 assets. We are required to support 100 assets so this will be done w multiple objects. This assumes a cache size of 20000.
AD_DATA	2		
LOGO_DATA	1		

Step 3 – nCUBE headers are added to each object. Each NC object header contains information about the total number of objects in the collection, the object index within the collection, etc. (see nCUBE object and segment header below).

Step 4 – Each object is broken down into a series of smaller segments. The default segment size is 534 bytes.

Step 5 – nCUBE headers are added to each segment. Each nCUBE header contains information about the total number of segments that comprise the object, the segment's position within the object, etc. (see nCUBE object and segment header below).

Step 6 – The segments are broken down into DC2Text messages and the DC2Text messages are carried as data in MPEG Transport Packets.

Preface

This document provides a description of the nCUBE VOD for TV Guide Interactive solution. This VOD solution from nCUBE enables fully interactive VOD services for Motorola DCT 2000 set-top boxes running the TV Guide Interactive Electronic Programming Guide (EPG).

With the nCUBE VOD Solution for TV Guide, service operators can quickly implement true interactive VOD on the Motorola HFC plant with no interruption to existing services.

This solution seamlessly integrates into any Motorola broadband network architecture. nCUBE has tested and integrated this solution to ensure that deployment timelines are rapid, startup costs are minimal, and service launch success is ensured.

What's in this Guide

This document includes the following sections:

Section	Contents
Chapter 1: VOD Overview	How does VOD work? VOD Experience Television Screen Captures
Chapter 2: System Architecture	System component list Architectural Overview
Chapter 3: Interactive Network Communication	Interactive Network Communications Metadata in the Interactive Network ODA 2.1.3 Upstream and Downstream Communications

Section	Contents
Chapter 4: VOD System Communications	Descriptions of the following VOD System Communications: • ODA Metadata Update • Set-top box self-discovery • TVG Interactive/nCUBE ODA Client download • Posting a billing event • Session Setup - Purchase Video • Session Setup - Resume Play • Session Teardown - End of Stream, Pause Limit Reached, or Stop
Chapter 5: System Administration	Plant ID Description and Configuration Transport Heartbeat Description nCannon Configuration Catcher's Mitt Description and Configuration Server Administration: • ODA 2.1.3 Client • ODA 2.1.3 Server • n4 Video Server • nABLE • nVS
Glossary	Terminology and Definitions

About nCUBE

nCUBE Corporation (www.ncube.com) is a leading solutions provider for the on-demand media market. The company offers cable operators and telecommunications network providers complete business and technology management solutions for advanced television services such as video-on-demand (VOD), subscription VOD (SVOD), network personal video recording (nPVR) and digital advertising insertion.

Chapter 1: VOD Overview

Video-on-Demand (VOD) is an interactive entertainment service that is deployed over the 2-way cable plant architecture.

Video-on-Demand services give users complete control over the television program viewing experience. The user has full-function VCR (virtual VCR) capabilities, including the ability to fast forward, reverse, pause, and restart a program.

This chapter includes:

- Overview of how a VOD system provides video sessions to subscribers
- Sample VOD User Experience through television screen captures

How Does VOD Work?

This section provides a high-level view of how the VOD system provides a streaming video session to a subscriber.

Content Acquisition

The service operator acquires content from content providers. The content is loaded onto the n4 video servers. Content management procedures — including encoding, loading, and distribution — are entirely dependent on the specific requirements of the service provider, and typically vary from operator to operator. nCUBE Professional Services has extensive knowledge and experience with content management procedures, and is available to consult with service operators to discuss best practices.

Content Storage

The n4 video server supports content libraries up to thousands of feature-length video titles. The unique n4 video server hypercube architecture eliminates the need for content duplication: A single piece of content can support thousands of simultaneous subscribers.

Metadata Management

Content product definition and availability is entered as metadata into the nCUBE nABLE system management application database. nABLE then publishes this metadata to the ODA server or servers.

Metadata includes the information about the product that is communicated to the subscriber through the TV Guide Interactive application. The metadata also includes system provisioning and billing data used by other VOD-enabling applications. Metadata can be manually loaded through nABLE Graphical User Interface (GUI), or metadata can be imported into nABLE via the nABLE XML API.

ODA Client Download

The ODA Client is a relatively small application. The ODA Client is uploaded onto the Motorola headend controller (DAC 6000) and pushed out to DCT 2000s on the out-of-band. The TV Guide Interactive client is pushed out to the set-tops in a similar fashion.

Video Purchase

When subscribers select the VOD option from TV Guide Interactive, the TVG application sends a request for data to the nCUBE Client Application, which is also running on the DCT 2000 set-top box. The nCUBE Client Application sends a request to the ODA Server for VOD menu metadata to display to the subscriber.

The ODA Server sends the current VOD menu metadata to the nCUBE Client Application, which translates the data to a TV Guide-specified format and passes the data to TV Guide Interactive. TV Guide Interactive then displays the data to the subscriber. This entire process takes only a split second.

Subsequent user requests are handled in the same fashion, with TV Guide Interactive communicating data requests with the nCUBE Client, which requests the data from the ODA Server and returns the data to TV Guide Interactive.

Video Streaming

When a user decides to purchase a VOD product and clears the TV Guide Interactive PIN authorization process, the TV Guide application sends a VOD purchase request to the ODA Client application. The nCUBE ODA Client application forwards the purchase request to the ODA Server, which handles the purchase and returns movie information to the ODA Client application. The ODA Client application communicates with the n4 video server to set up a session, and the n4 prepares to stream the requested VOD product. Meanwhile, the ODA Client application forwards the VOD buy message to the ODA Server, which logs the purchase and posts the event to the nABLE Billing and Provisioning Service (BPS). The nABLE BPS communicates the purchase information to the operator billing system.

The n4 video server communicates with the nABLE RT system management application, which assigns network resources for the streaming, reserves a bandwidth channel for the session, and authorizes the n4 to stream the session.

The n4 video server returns session destination information to the ODA Client. The client uses this information to get a virtual channel number (VCN) that the movie will be played on, and then it sends a Play command. The ODA Client requests that the TV Guide application tune to the VCN it receives from the RTSP Server. Once tuned, the client notifies TV Guide Interactive that a session has started and TV Guide removes the Guide UI and displays the video.

VCR Controls (Trick Play)

If the user decides to rewind, fast-forward, or pause the movie, the request is passed by TV Guide Interactive to the nCUBE Client application and then to the n4 video server, which responds accordingly.

When the n4 reaches the end of the file it is streaming, or if the user pauses the session for a defined amount of time, nABLE ends the streaming session. The ODA Client submits a request to teardown the session and returns the user to TV Guide Interactive. The ODA Client sends a Resume Position value to the ODA Server, so that the user can begin watching the movie where they left it the next time they watch.

nABLE reclaims the bandwidth and assigned resources to the pool of available resources.

Purchase Experience Television Screen Captures

TVGuide Main Page

Figure 1-1 is the TVGuide Main Page. The highlighted selection "VOD" is the link that takes the user into video-on-demand menu. The "VOD" button can be labeled according to the operator's specification. For example, an operator may choose to label this button "Videos" or "Movies".

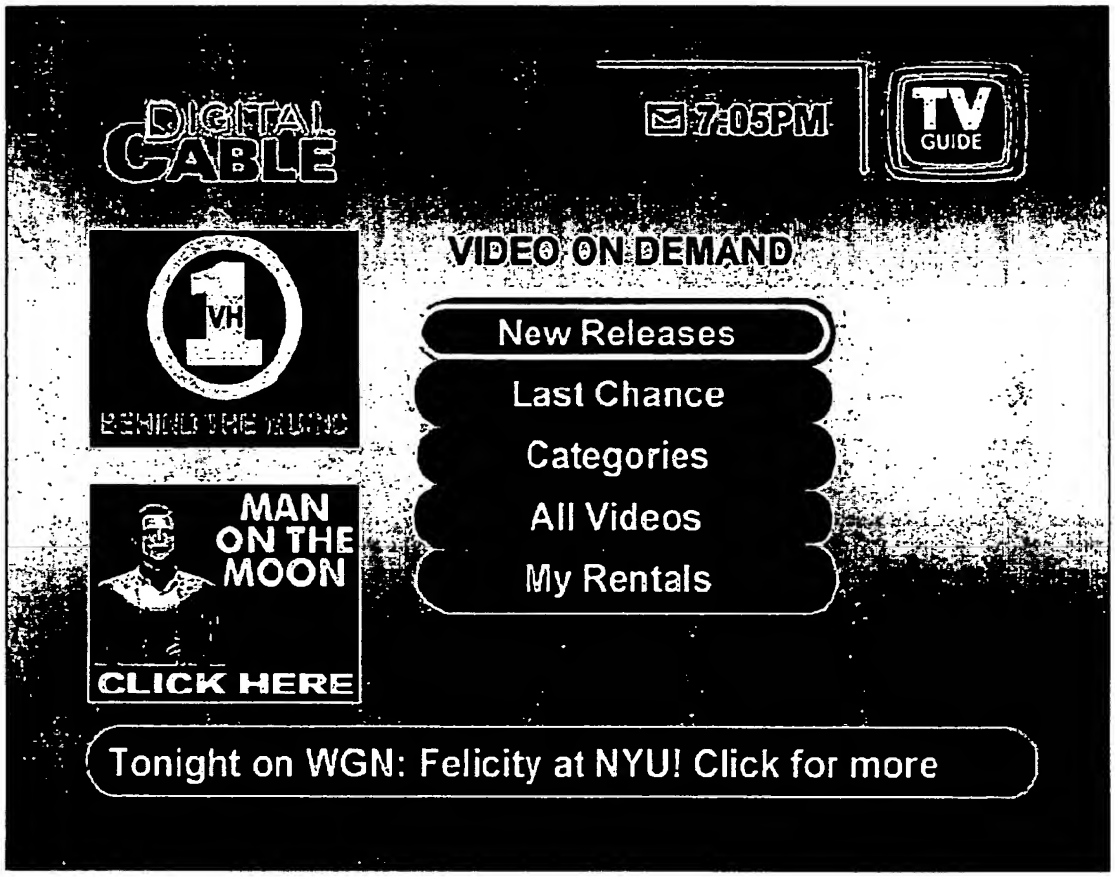
Figure 1-1: main page

Video-on-Demand Main Page

Figure 1-2 is the main page for VOD accessed by clicking on "VOD" from the screen capture above on the left. These main page categories are completely customizable,

giving the operator the ability to define unique product offerings such as All Videos, Last Chance, and New Releases.

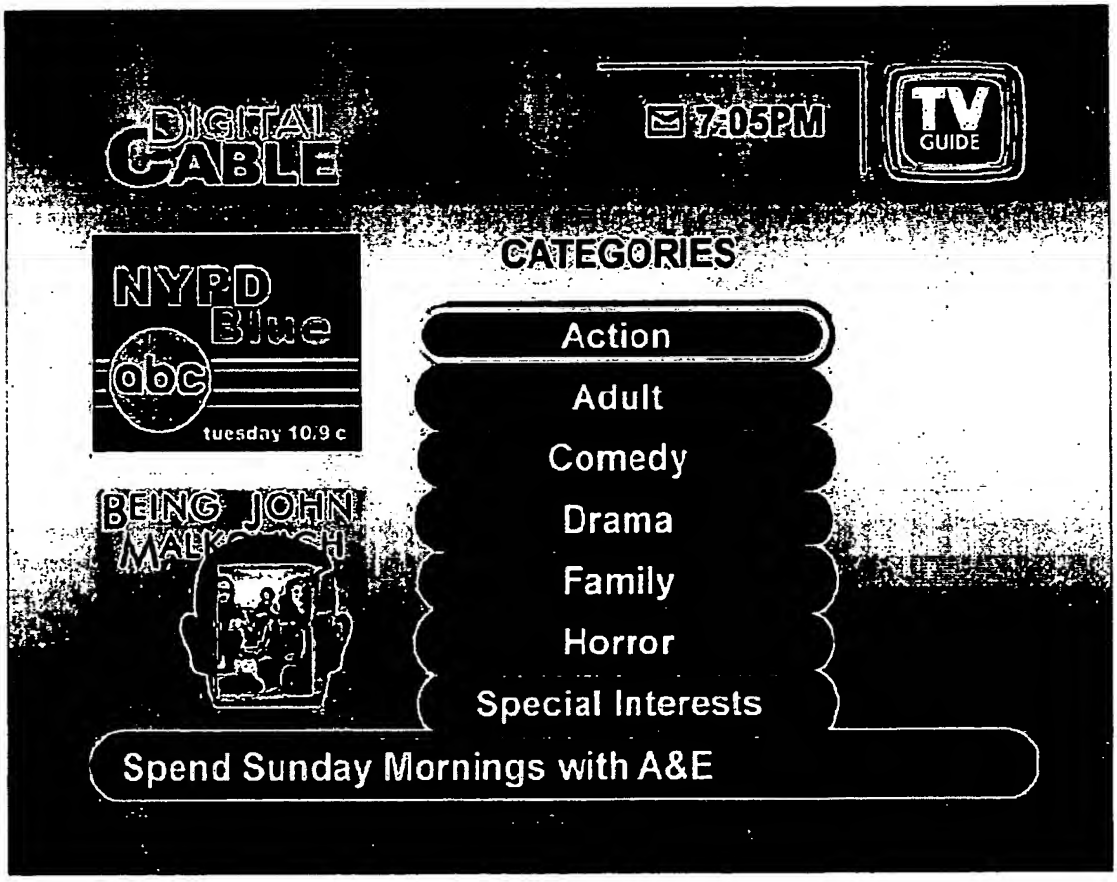
Figure 1-2: Video-on-Demand Main Page



Categories

Figure 1-3 is the screen that is displayed after selecting the "Categories" link on the VOD main page. Categories are completely customizable, giving operators the ability to group video titles into specific offering such as Drama, Action, Special Interests, etc.

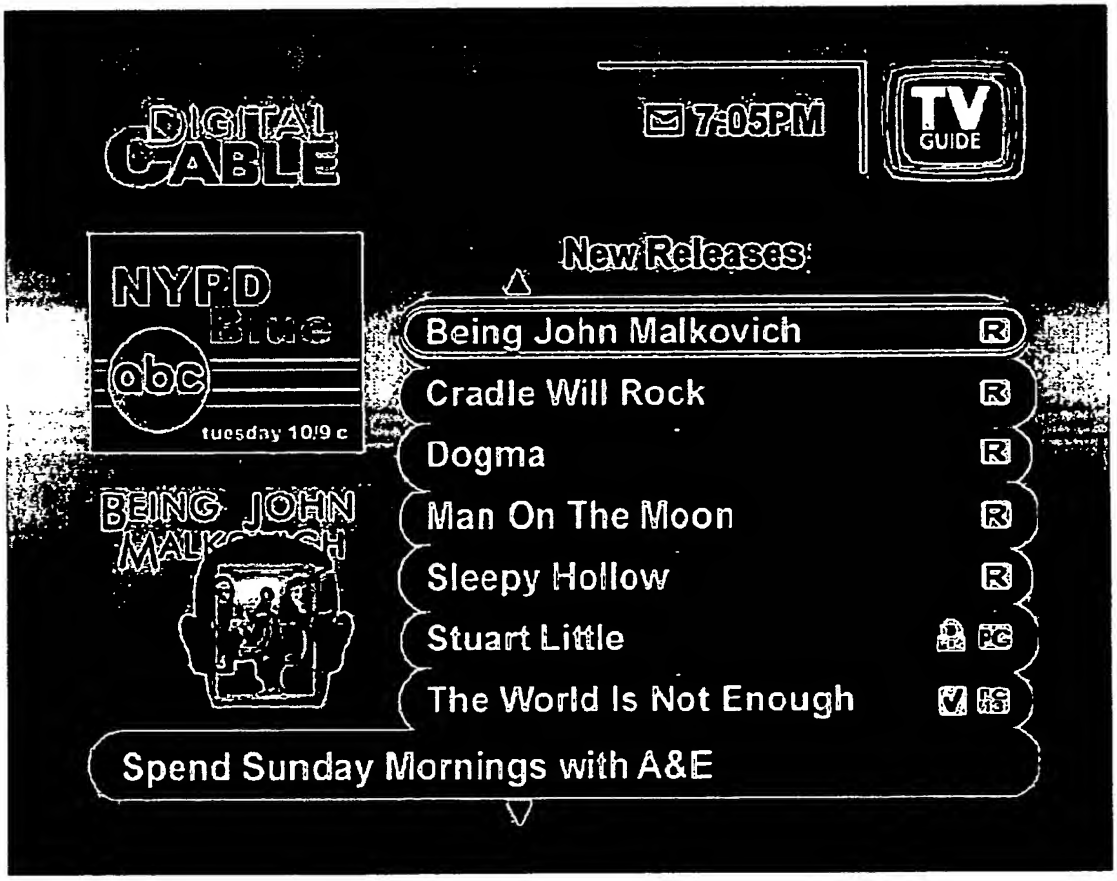
Figure 1-3: Categories



Movies within a Category

Clicking on the "New Releases" category in the previous screen takes the user to a title selection screen for that category, which is shown in Figure 1-4.

Figure 1-4: Movies within a category

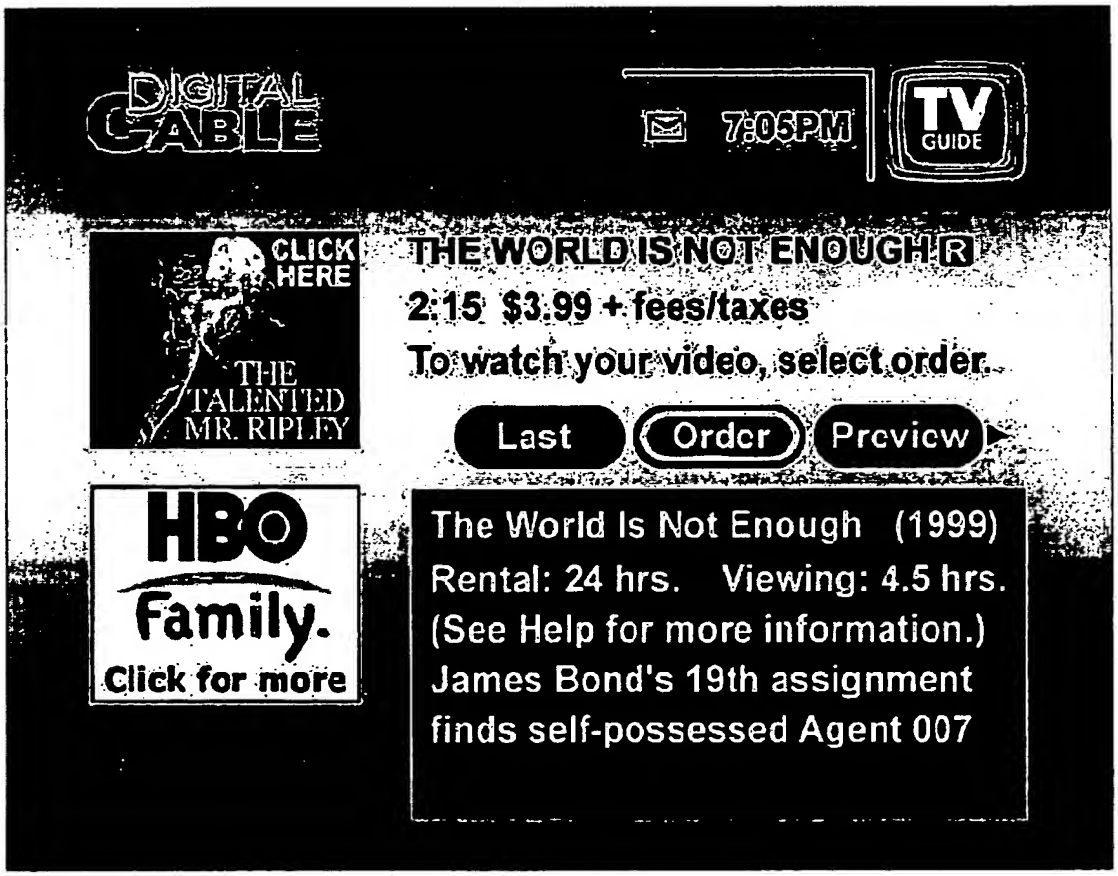


Movie Details

When a user selects a particular movie title, the user sees a movie details screen, which is illustrated in Figure 1-5. The movie details screen contains detailed information for the selected movie, including description, actors, price, and poster art.

When the customer chooses to order a specific movie, if it is of a rating that has been blocked, a PIN entry is required. The customer is then asked to confirm his/her purchase before the movie begins showing.

Figure 1-5: Movie Details



Movie Streaming

Finally, Figure 1-6 illustrates what the user sees when a movie begins streaming. An on-screen display (OSD) message momentarily displays a confirmation message.

OSD text messages are completely customizable, allowing operators to provide deployment-specific information in the OSD messages. The customer also sees the trick-play options, the title of the movie, and the time remaining on the movie.

Figure 1-6: Movie Streaming

Chapter 2: System Architecture

This section includes:

- Solution component list
- Architectural overview

Solution Components

Table 2-1defines the system components and version numbers that comprise the nCUBE VOD for TV Guide Interactive solution.

Table 2-1: Solution Components

Component	Description	Notes
DCT-2000 Hardware Versions	R4, R41, R6, R7, R8	
DCT-2000 Firmware Versions	7.54	
TV Guide EPG	TVGi A14	A12 integration in progress
Content	3.75 Mbps, 2 Channel AC3 audio	
ODA Client	nCUBE ODA Client 2.0	DCT-2000 client supporting ODA 2.1.3 and nABLE 1.7.2
ODA Server	nCUBE ODA Server 2.1.3	
VOD System Manager	nCUBE nABLE 1.7.2	
Video Server	nCUBE n4	
Video Server Operating System	nCUBE Transit 3.1.1	
Video Server Pump	nCUBE nVS 3.5.4-2	

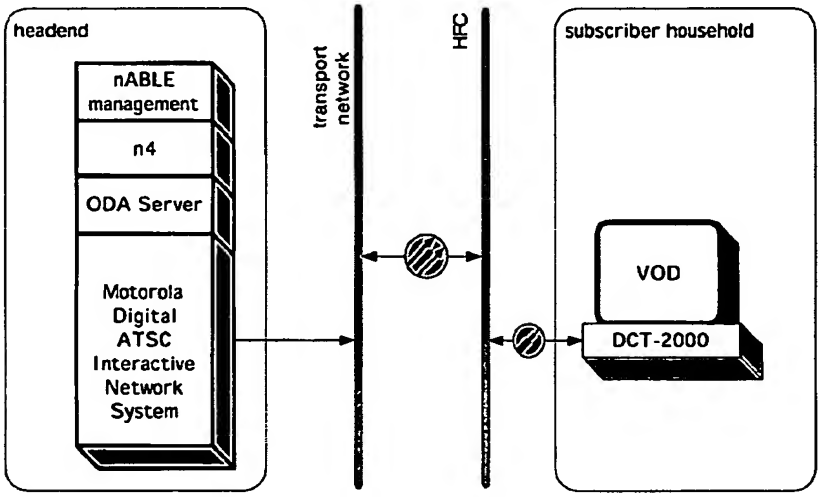
VOD Architectural Overview

The essential components of the nCUBE VOD for TV Guide solution are:

- nCUBE n4 Streaming Media System
- nABLE VOD System Management Application Suite
- Motorola Digital ATSC Interactive Network System
- Motorola DCT 2000 set-top boxes equipped with the TV Guide Interactive application

These system components are logically illustrated in Figure 2-1, and each system component is described in detail below.

Figure 2-1: VOD for TV Guide System Architecture

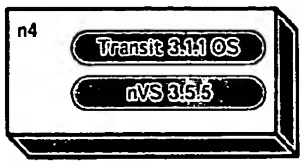


nCUBE Streaming Media System

The n4 Streaming Media System is the video server system responsible for streaming content out to the Motorola digital network. The n4 streaming media system includes:

- n4 Streaming Media Appliance
- Transit 3.1 video server operating system
- nCUBE Video Server (nVS) 3.5.5

Figur 2-2: n4 System C mpon nts



n4 Streaming Media Appliance

The n4 video server stores the VOD content library, handles streaming media requests, and outputs video streams in QAM Intermediate Frequency (IF) format to the Motorola upconversion equipment for transport over the digital system.

The n4 Streaming Media Appliance is a purpose-engineered video server with the unique ability to service thousands of simultaneous stream requests using a single copy of the content file.

The n4 is a fourth-generation video server running the most robust advanced streaming media software applications available.

Transit video server operating system

Transit, the n4 operating system, is a high-performance kernel designed specifically to support streaming media applications, such as the nCUBE Streaming Video Server. The Transit OS is resident on the n4.

nCUBE Video Server (nVS)

nVS is a scalable video software engine that stores video and delivers broadcast-quality, interactive services to the home and desktop. nVS resides on the n4 video server.

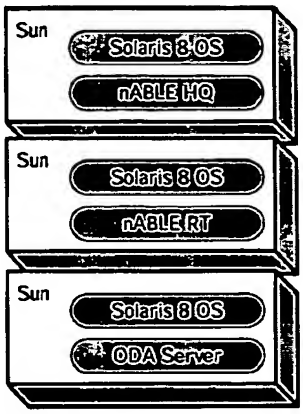
nABLE VOD System Management Application Suite

The nABLE Application Suite includes a number of modular applications that together comprise a complete VOD system management application suite. The nABLE applications include open APIs for interdependency with other headend applications and network equipment.

The TV Guide Solution architecture uses these nABLE applications:

- nABLE Headquarters (HQ)
- nABLE Realtime (RT)
- nABLE On-Demand Application (ODA)

Figure 2-3: nCUBE nABLE and ODA components



nABLE HQ

The nABLE HQ server application is the central VOD system manager. nABLE HQ stores information about content as *metadata* and sends the metadata to the ODA Server. nABLE HQ is hosted on a Sun Enterprise or Netra server running Solaris 2.8.

nABLE HQ is also responsible for system configuration, file management, metadata management and systems operations monitoring. nABLE HQ provides an operator interface via HTML pages that can be viewed with the Microsoft Internet Explorer 5.5 browser.

Specific nABLE HQ functional capabilities include:

- Serving the system management graphical user interface (GUI)
- Providing detailed historical data for all VOD sessions
- Administering system users, passwords, and permissions
- Storing the system configuration and network topology
- Managing content distribution and registration for each n4
- Defining product metadata and purchasable event information
- Reporting session setup and stream usage statistics
- Providing a Quality Assurance System for product metadata management
- Storing and serving product metadata to the ODA set-top box application
- Providing HTML-based documentation and context-sensitive Help

nABLE RT

nABLE RT performs intelligent network resource allocation and load balancing. nABLE RT maintains a complete inventory of the streaming media network resources available, and assigns network resources for each streaming session. nABLE RT updates the network configuration map in realtime, performing load balancing and bandwidth allocation for the streaming media system. In effect nABLE RT is the

traffic manager handling all the streaming session requests coming in to the system, and in turn managing the network resources that stream video.

nABLE RT is typically hosted on a Sun Enterprise or Netra server running Solaris 2.8. Depending on the network topology and size, operators may deploy multiple nABLE RTs.

nABLE ODA Server

The ODA Server communicates information about available content offerings from nABLE HQ to the set-top box client application. The ODA Server also communicates billing posts to the nABLE Billing and Provisioning Service (BPS).

Motorola Digital ATSC Interactive Network System

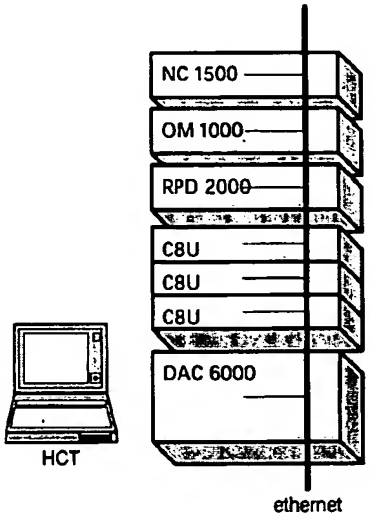
The Motorola network comprises a complete headend-to-subscriber digital system. The Motorola network has a realtime return path enabling interactive television services including Video on Demand.

The Motorola Network for the TV Guide solution includes the following integral system components:

- DAC 6000
- NC 1500
- OM 1000
- RPD 2000
- C8U
- HCT

These components are logically illustrated in Figure 2-4.

Figure 2-4: Motorola Interactive Network Components



DAC 6000

The DAC 6000 is the headend management center, providing definition for all the Motorola system components in the headend. Relative to the VOD system, the DAC 6000 core functionality includes:

- Configuring terminal communications and client application code downloads
- Scheduling services and programs
- Defining channel map assignments
- Configuring headend components
- Supporting interactive network functions
- Interfacing to network management devices

NC 1500

The NC 1500 is the headend component that enables realtime, two-way interactive applications on the Motorola network.

The NC 1500 manages set-top box power management, upstream data channels, and IP routing. The NC 1500 is also responsible for forwarding out-of-band MAC and set-top box application data to the OM 1000.

OM 1000

The OM 1000 provides the out-of-band (OOB) data path to the DCT 2000. The OM 1000 also multiplexes MPEG-2 streams for downstream delivery.

RPD 2000

The RPD 2000 (Return Path Demodulator) is the upstream communications device for communications with the DCT 2000s.

C8U The Commander 8 Upconverter (C8U) is the IF-to-RF ramp in the solution, converting the QAM IF output from the n4 to QAM RF format for transport over the cable HFC plant.

HCT The Headend Configuration Tool is a portable device (laptop PC) that interfaces with the other headend components. The HCT provides the tools necessary to configure network devices such as the NC 1500 and the OM 1000.

Motorola DCT 2000 Set-top Boxes

The Digital Addressable Interactive Digital Consumer Terminal (DCT 2000) is the set-top box in this solution. The DCT 2000 is the host for the TV Guide EPG and the nCUBE Client Application.

Figure 2-5: DCT 2000 Components

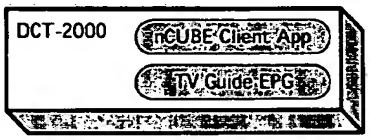
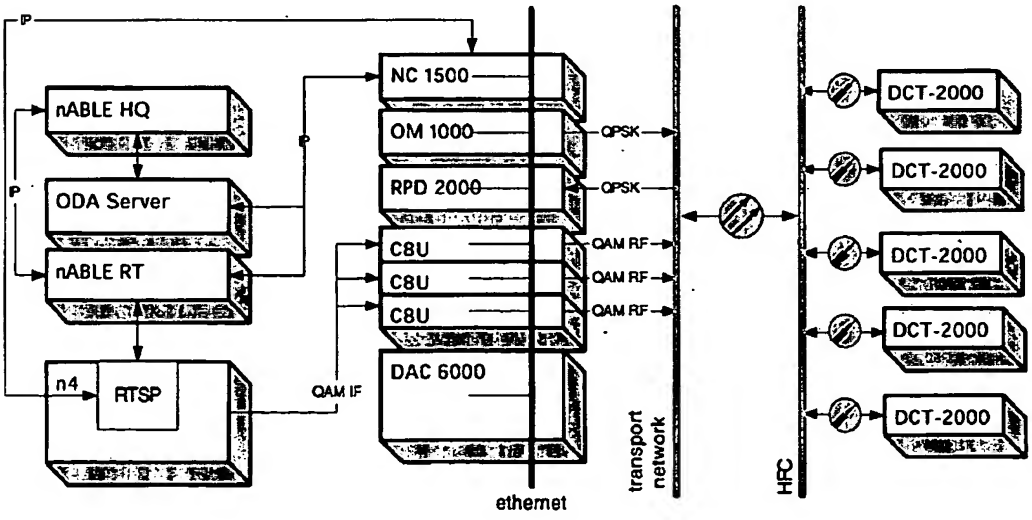


Figure illustrates the logical network architecture at the major system component level.

For detailed system communication between system components, see the *System Communications* chapter of this guide.

Figure 2-6: Logical Network Architecture of Major System Components



Chapter 3: Network Communications

This section includes descriptions for:

- Interactive Network Communications
- ODA 2.1.3 In-Band Communications
- ODA 2.1.3 Out-of-Band Communications

For detailed descriptions of the VOD messages passed over the interactive network, see the System Communications section of this document.

Interactive Network Communications

From a network communications standpoint, the defining characteristic of the interactive television system is the internetworking between an RF-based digital cable network and IP-based Ethernet network. Consequently, all data communications between these two networks must be modulated or demodulated to a data format acceptable to the recipient device or program.

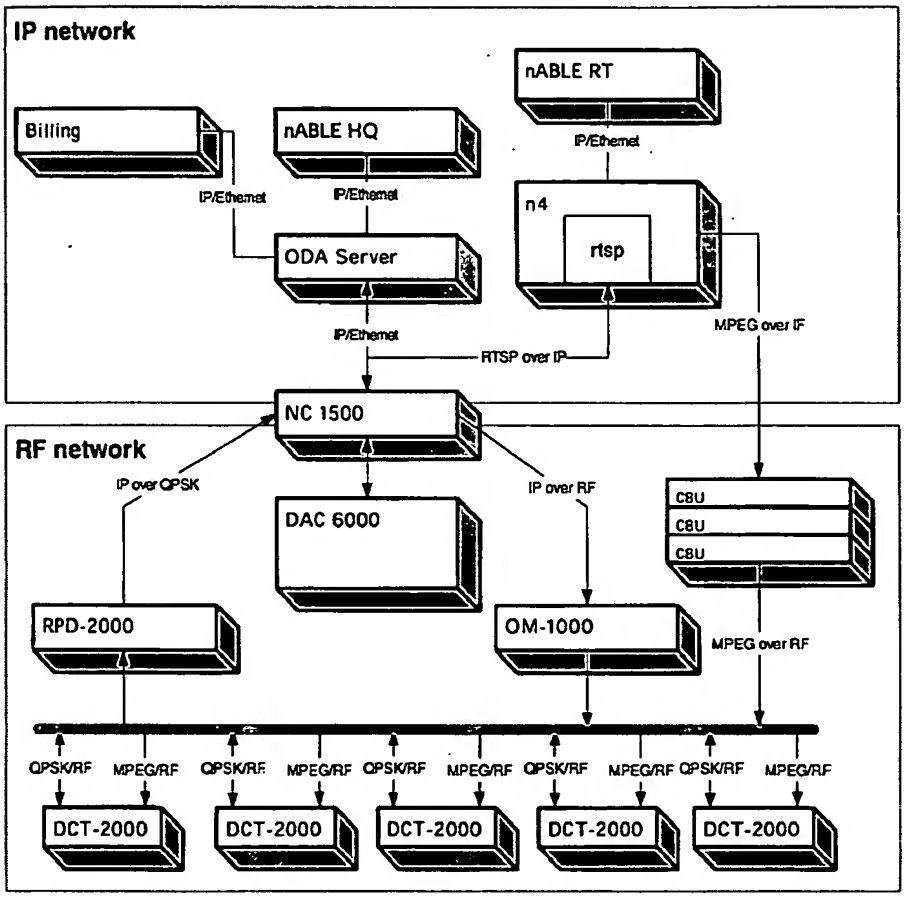
The Motorola Interactive Network fully supports interactive communications between DCT 2000 set-top boxes and the interactive VOD network. Specifically, the Motorola Network Controller 1500 (NC 1500) acts as the gateway between the RF and the IP network. The NC 1500 employs a proxy function between User Data Protocol/Internet Protocol (UDP/IP) and Simple Connectionless Protocol (SCP) that enables DCT 2000 terminals to communicate with interactive application servers.

The 2-way, interactive communications-enabling components in the Motorola network are:

- The Return Path Demodulator (RPD-2000), which receives, demodulates, and processes upstream communications data from the DCT 2000 network and forwards the data to the NC 1500
- The Out-of-Band Modulator (OM 1000), which receives MPEG 2 streams from the NC 1500 and modulates the data onto an RF signal for delivery to the DCT 2000s set-top boxes downstream.

An overview of network communications is illustrated in Figure 3-1.

Figure 3-1: Network Communications: Logical View



Interactive Network Communications

Data and metadata exchanges between the VOD server system and ODA Clients can be sent in-band (IB) or out-of-band (OOB). Both the IB and OOB have characteristics that make the one better-suited that the other for carrying different types of network data. For example, subscriber-unique, dynamic requests are best handled through the OOB back-channel, while common-to-all product metadata is best broadcast within the IB spectrum.

nCUBE has engineered interactive network solutions that take advantage of the characteristics of both IB and OOB client/server communications. For Motorola HFC networks, these engineering efforts have culminated in the ODA 2.1.3 release. In this release IB communications include MPEG movie data, forward-path movie metadata, and certain control data such as Plant ID information. OOB communications include all subscriber-specific and dynamic metadata communications in both the upstream and downstream.

It is the goal of nCUBE engineering to use the IB for the majority of Client/Server downstream communications. Future versions of the nCUBE ODA server will put nearly all client control and client configuration data on an in-band carousel, including Plant ID, ODA Server and Video Server addressing information, and graphic images. The OOB will be used for dynamic, subscriber-specific data requests only.

The methods nCUBE implements to handle interactive network communication in the in IB and OOB spectrums are described below.

ODA 2.1.3 In-Band Communications

In the ODA 2.1.3 architecture, the in-band is used for the delivery of MPEG data (content), DC2TEXT (metadata), and certain control data (Plant ID) via QAM 64 or QAM 256-encoded multi-program transport streams (MPTS).

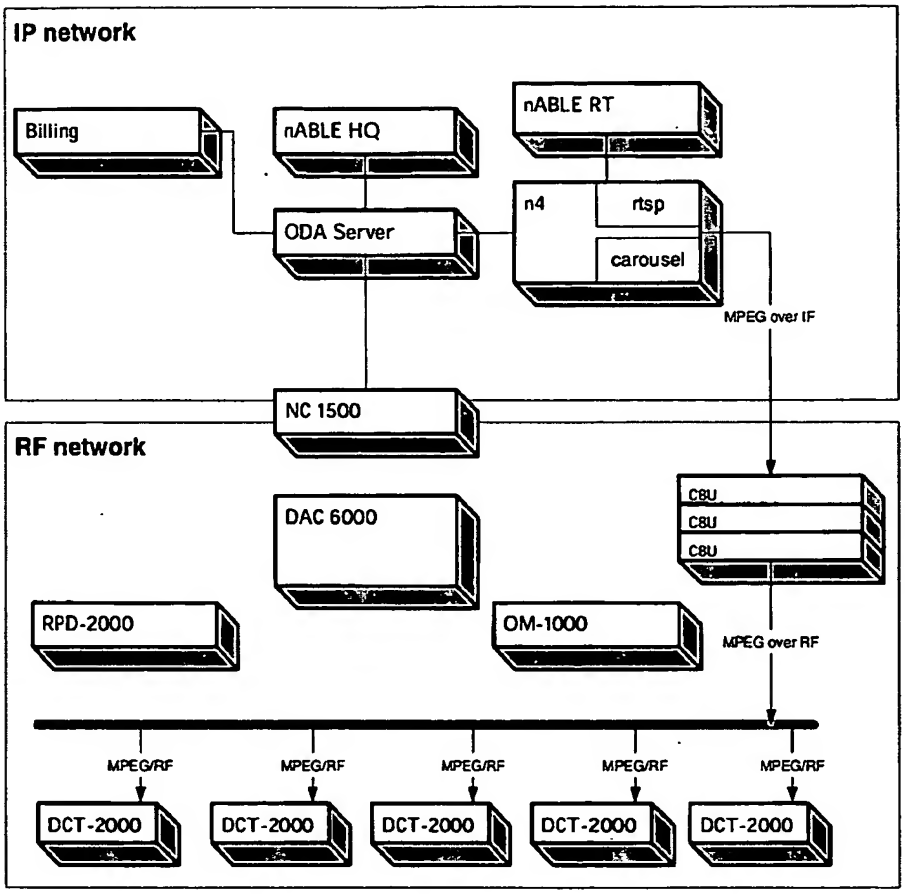
In-band communications include:

- Video stream transport, including movies and trailers streamed from the n4 video server to the C8Us. The C8U upconverts the IF stream to a QAM 64 or QAM 256 RF stream, where it is then delivered in-band to the HFC network and the DCT 2000 set-top box.
- Static metadata such as movie description and pricing information. Static metadata is encapsulated in DC2TEXT, wrapped in MPEG-2 transport, carouseled on the n4 video server and streamed via the C8U
- Plant ID information that allows the set-top box to "self-discover" its service group. Plant ID data is also encapsulated in DC2TEXT, carouseled and streamed over the in-band via the C8U.
- A static Cover Stream mechanism for tuning the DCT 2000

Each of these in-band communications is discussed in detail below.

The in-band communications path is illustrated in Figure 3-2.

Figure 3-2: In-band communications: logical view



In Band Metadata

Scaling the VOD system to accommodate thousands of users requires IB resources in addition to existing OOB UDP bandwidth. Especially problematic is forward-path movie metadata (toward the set-top) that must exist in an already congested 1.5 Mbps OOB channel.

nCUBE addresses the issues associated with forward-path movie metadata in the ODA 2.1.3 release. The goals of ODA 2.1.3 are (1) minimize VOD navigator transactions in general (2) and eliminate all static metadata on the OOB, which represents in excess of 90% of all ODA data transactions. Depending on the amount of movie metadata, IB and OOB resources could be combined on unused QAM bandwidth, allowing all subscribers to simultaneously surf the ODA server without consuming any QAM video bandwidth – an economically compelling solution.

Background

Earlier versions of the nCUBE ODA solutions for Motorola environments handled client requests for metadata exclusively OOB. Scaling the TVGi solution meant pulling movie metadata out of the OOB and placing it on the IB. However, this is more complicated than simply using another segment of plant bandwidth to transport the metadata. In-band data cannot be sent as UDP data, and there is no IB return path. Instead, all IB data is forward-path, must be wrapped in MPEG-2 transport, and must exist in the DCT proprietary payload format "DC2TEXT." The DCT return path is always UDP OOB.

To receive IB metadata, TV Guide enhanced their EPG tuning code in version A14 to receive **UDP- OOB** or **DC2TEXT-IB** transparently. For UDP sessions, the ODA client application uses the socket_open () and socket_read() functions. For DC2TEXT sessions, the ODA client application uses the tune(), select_component(), and read_component() functions. From the client's perspective, these methods are quite similar.

On the server side there are two potential methods of creating DC2TEXT-IB metadata: a session-based method and a carousel-based method. Each method has its respective advantages depending on the amount of movie metadata and the available IB bandwidth. For the 2.1.3 product, nCUBE has engineered a carousel method to send metadata and control data in-band.

In-band Data Carousels

An in-band data carousel is a continuous, looping MPEG stream on a pre-determined virtual channel number (VCN). The ODA client on the set-top box tunes the VCN and extracts payload packets from the MPEG stream that contain either Plant ID data for the client or metadata for the TV Guide EPG. The carousels are created by the ODA server, copied to the n4 video server, and then streamed by the n4 video server. The in-band carousel is an effective mechanism for delivering downstream data and metadata, shielding the limited OOB spectrum from a significant number of frequent client requests.

Client/Server Communications

The ODA Client initializes when a household subscriber selects VOD from the TV Guide EPG. When the ODA Client initializes, it discovers its ODA Server's IP address using a firmware API that accesses the NC 1500 hosts file, where the ODA Server's IP address is registered. It does this on the OOB using the 256 Kbps backchannel through the RPD 2000. The NC 1500 sends the IP Address to the client via the OM 1000 out-of-band downstream channel.

Once the DCT 2000 client has the ODA Server IP address, it opens a connection to the ODA Server. It does this by sending an ALOHA-formatted message through the 256 Kbps return channel, which is handled by the RPD 2000. The RPD 2000 formats the message into standard Ethernet frames and forwards the data to the NC 1500. The NC 1500 parses the Ethernet frames and forwards the data to the ODA Server.

The ODA Server returns a set of control data to the ODA Client that includes a list of Virtual Channel Numbers (VCNs) to tune. The ODA Client uses these VCNs to discover its RTSP server list, tune the Plant ID carousel, and tune the movie metadata carousel.

Once the ODA client tunes the first pre-defined VCN, it will find its *Plant ID carousel*. The ODA client then reads the Plant ID carousel data stream, pulling out DC2TEXT data that has been inserted into the MPEG-2 file by the ODA Server. The carousel data

includes the Plant ID for that set-top box. The ODA Client caches its Plant ID, which it will include in any stream provisioning requests it sends to the VOD system.

Once the ODA Client has its Plant ID, it tunes the *metadata carousel*, which is streaming on another pre-defined VCN. The metadata carousel feeds the client the static movie product metadata that the ODA client passes to the TV Guide application for presentation to the subscriber. The movie metadata is encapsulated in DC2TEXT messages that are inserted by the ODA server into the private data space of the MPEG file. The ODA Client reads the metadata out of the MPEG stream and caches it on the set-top box. This static metadata includes:

- Categories to Display
- Movie titles
- Movie details including rating, price, actors, and plot description

Subsequent client/server communications, such as stream requests and dynamic metadata requests, take place on the OOB and are described below in *ODA 2.1.3 Out-of-Band Communications*.

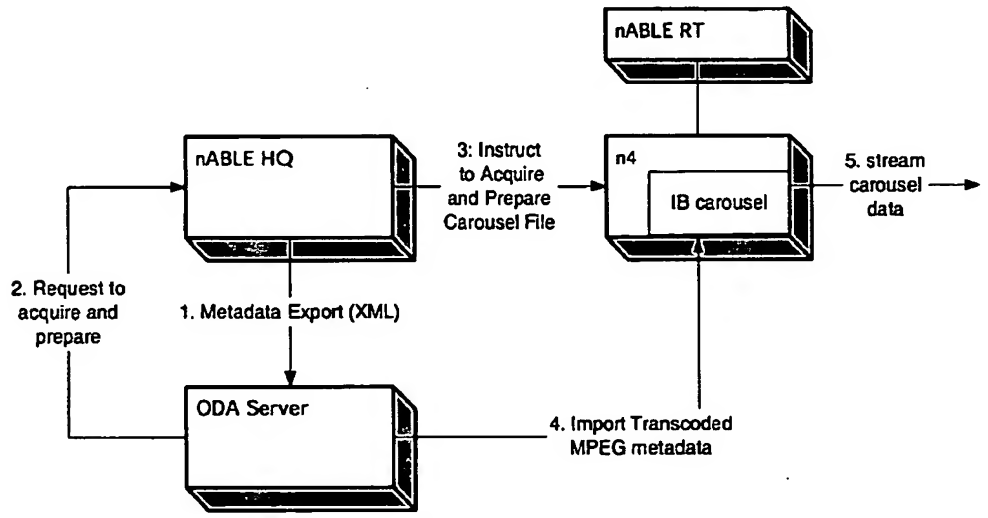
Creating and Managing Carousels

Building a carousel starts with an ODA server process that executes an SQL script to extract XML data from the ODA server database. This carousel creation process can be initiated by a cron job and/or through a push notification from nABLE HQ. The ODA server then transcodes the data to DC2TEXT and wraps the data with MPEG-2 transport. This process is the same for the creation of both the Plant ID and the movie metadata carousels.

Once the MPEG-2 carousel file is generated, the ODA server then notifies nABLE HQ that the file is available. nABLE HQ copies the MPEG file to the IB carousel directory on the n4 video server, instructs the video server to prepare the file for downstream transport, and communicates instructions on when and how to stream the file. The video server accesses the file, prepares the file, and streams the file per the ODA server instructions.

For example, in the 2.1.3 architecture the nABLE HQ application exports XML-formatted movie metadata to the ODA server. The ODA server converts the metadata to DC2TEXT format and inserts the metadata in an MPEG-2 file. The ODA server then sends a message to nABLE HQ requesting that the MPEG file be acquired (ftp) and prepared (tagged) for streaming. nABLE HQ informs the video server about the new carousel file and instructs the video server to prepare. The n4 tags the file and begins streaming as instructed. This process is illustrated in Figure 3-3.

Figure 3-3: M tadata Carousel



Versioning

Updates to the movie metadata are handled essentially through replacing the MPEG file to stream in the IB carousel. In the nCUBE architecture, updates to the metadata collection would be input through the nABLE HQ interface, published to the ODA server, which would then prepare the MPEG-2 file and request acquisition with the streaming media system as described above.

For 2.1.3, the ODA Server stamps a version number on each DC2TEXT payload packet. Once the ODA Client has acquired the IB metadata carousel and filled its cache, the ODA client will continue to use the cache until it determines that the data carousel version has changed. The ODA Client application will refresh its metadata cache when it reads a new version number in the carousel data beginning with the first packet with the new version number. If the metadata carousel is not available for version detection, the ODA Client will continue to use the cache it has already acquired.

While the user is navigating the VOD User Interface, the ODA Client continuously monitors the data carousel versioning looking for changes.

Plant ID Carousel

From the perspective of the ODA system, the creation of the Plant ID carousel is identical to the Metadata carousel. The only logistical differences for this carousel concern the source of the data that is placed on the control data carousel.

The Plant ID carousel is essentially a control data carousel. nCUBE envisions that the control carousel will be used for a number of purposes in future versions of the nCUBE ODA server product. Among other things, nCUBE anticipates that a carousel or multiple control carousels will be used for client configuration data, graphical image and logo transfers, and ODA server and video server addressing information.

Caching the Carousel Data

The ODA Client stores the data it extracts from the Plant ID carousel and the metadata carousel in memory. The ODA Client uses the Plant ID data to report its service group to the nABLE bandwidth management application, and it uses the metadata cache to pass information to TV Guide Interactive application for the subscriber browsing experience.

The TV Guide application sets a 64 kilobyte cache (heap memory) limitation on the ODA Client. The ODA Client application processes require approximately 10 kilobytes of this allocation, leaving an approximate 55 kilobyte container of memory in which to cache movie metadata.

Consequently, there is a trade-off in the total number of movie assets the client can cache against the total amount of metadata per individual movie asset the client can cache. For example, MSOs could choose to cache many movie titles with only a small amount of description metadata per asset, or they could cache detailed description metadata for a smaller number of movie assets.

In future versions of the product, the ODA client will support multiple metadata carousels. Multiple carousels will allow the client to rapidly recycle cached metadata, providing a means for any number of approaches for sending metadata downstream. nCUBE intends to work with its customers to determine the best way of caching movie metadata client within the allotted 55 kilobytes using multiple metadata carousels.

For more information on metadata sizing considerations, see *Movie Metadata: An Analysis* below.

Static Cover Stream

Because the tuner on the DCT 2000 requires a ratio of null data to payload data within the QAM, the DCT 2000 firmware cannot tune a low-bitrate DC2TEXT stream unless there is other payload data within the QAM. (Motorola is aware of this issue.)

While an MPEG movie streaming on the QAM fulfills the set-top box tuning requirement and enables set-tops to tune low-bitrate DC2TEXT carousels, set-tops cannot tune low-bitrate DC2TEXT Plant ID and metadata carousels if there are no MPEG streams on the QAM.

nCUBE implements a *Cover Stream* mechanism that fulfills the set-top box tuning requirement and enables the set-top to tune the low-bitrate in-band data carousels. This Cover Stream is essentially an MPEG-2 black video stream encoded at 2.0 Mbps or higher to meet the null data-to-payload data ratio requirement.

For the 2.1.3 release, the cover stream mechanism is static and must stream on a single QAM within each service group. In future releases, the cover stream mechanism will be dynamically allocated on the QAM as required to ensure the null data-to-payload data ratio requirement is met on that QAM. By dynamically allocating the cover stream, the full bandwidth of the QAM is potentially available for streaming video.

Third-party ODAs

nCUBE has engineered this solution so that any third party ODA server product could easily integrate into the architecture. The ODA server would need to support (1) an export process of metadata and/or control data in MPEG-2 format and (2) an acquisition request message to nABLE. The MPEG files could then be placed in the IB carousel on the video server for downstream transport to the ODA client, which would need to be enabled to tune the carousel and extract the relevant metadata and data.

TV Guide Metadata

All TV Guide Interactive Electronic Program Guide (EPG) Metadata is sent out-of-band through the OM 1000. There are two sources of TV Guide metadata:

- Headend in the Sky (HITS)
- Live Feed Generator (LFG)

In either case, the guide metadata passes through the OM 1000 for out-of-band delivery to the TV Guide Interactive client.

nCUBE ODA 2.1.3 has been tested and integrated with both LFG and HITS.

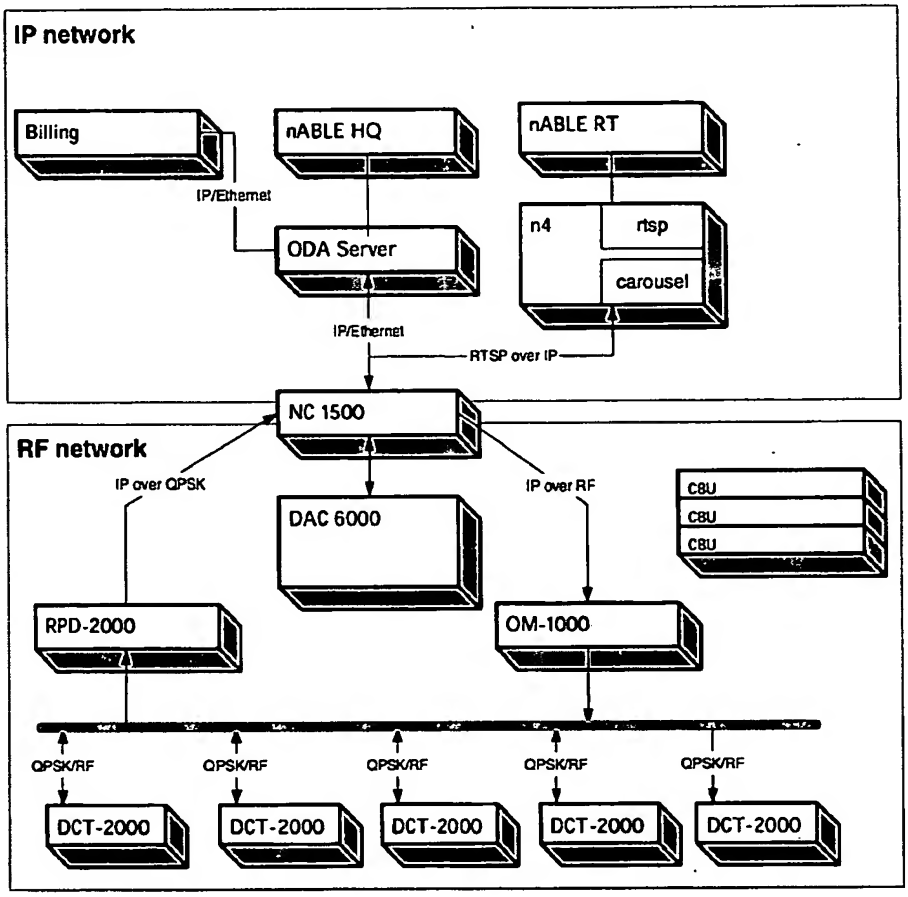
ODA 2.1.3 Out-of-Band Communications

In the ODA 2.1.3 architecture, the out-of-band is used primarily for provisioning data communications including:

- Set-top box firmware, TV Guide Interactive client, and nCUBE client downloads to the DCT 2000
- All upstream communications between the ODA Client and the ODA Server
- All subscriber-specific (dynamic) metadata
- All session management messages (fast forward, rewind, etc.) between the DCT 2000 and the n4 video server

Figure 3-4 provides a logical illustration of out-of-band communications in the nCUBE VOD Solution for TV Guide Interactive.

Figure 3-4: Out-of-band Communications: Logical View



In addition to ODA client data, the OOB supports generic application, EPG, and EPG-metadata. In the ODA 2.1.3 release, nCUBE implements an in-band metadata delivery method that ensures its customers have a reliable, scalable solution for their specific requirements.

Firmware and DCT 2000 client application downloads

Client applications are downloaded to the set-top boxes using the DAC 6000 management console application. Essentially, the client application is loaded onto the DAC 6000, configured as an object, and pushed out to the DCT 2000 set-top boxes.

nCUBE provides detailed instructions on the client download procedure using the DAC 6000 software in *Appendix A: Motorola Headend Configuration.*

Dynamic Metadata Communications

The TV Guide application notifies the ODA Client when a provisioning request is made in the user interface. For example, a subscriber may navigate to the My Rentals

page, which requires subscriber-specific (dynamic) metadata. Or the subscriber may make a purchase request, in which case session provisioning data is passed to the ODA Server.

In the event of a provisioning request, the ODA Client sends a ALOHA-formatted request to the ODA server through the 256 Kbps return channel, which is handled by the RPD 2000. The RPD 2000 formats the message into standard Ethernet frames and forwards the data to the NC 1500. The NC 1500 parses the Ethernet frames and forwards the data to the ODA Server.

The ODA Server then sends the dynamic metadata to the ODA Client through the NC 1500. The NC 1500 facilitates the downstream communications from the ODA Server to the Client by taking the Ethernet data from the ODA Server, checking the destination DCT 2000 IP address against its database, and reformatting the data into an MPEG-2 stream. The MPEG data is then sent over UDP to the OM 1000, which multiplexes out-of-band communications into a Quadrature Phase Key Shifted (QPSK)-modulated signal for RF downstream transport on a 2 Mbps OOB channel.

The ODA Client then receives this data on the socket it uses to listen for ODA Server communications.

Subsequent provisioning and dynamic metadata communications between the ODA Server follow the same paradigm, with upstream communications routed and converted through RPD 2000s and the NC 1500 and downstream communication routed and converted through the NC 1500 and the OM 1000s.

nCUBE provides a detailed analysis of the network traffic taking place on the OOB in the document: *TV Guide Out-of-Band Traffic Analysis*.

Movie Metadata: An Analysis

The movie metadata itself is a maximum of 566 bytes per asset, stored in the database in the following format:

```
typedef struct _VOD_VideoInfo
{
unsigned short versionId; (1)
unsigned long assetID; (4)
VOD_VideoRating rating; (2)
unsigned char title[MAX_VIDEO_SHORT_TITLE_LENGTH];
(20)
VOD_AssetType assetType; (2)
unsigned char longTitle[MAX_VIDEO_LONG_TITLE_LENGTH];
(40)
char priceInfo[MAX_PRICE_LENGTH]; (32)
unsigned long runTime; (4)
unsigned long viewingWindow; (4)
unsigned long rentalWindow; (4)
unsigned long freeWindow; (4)
unsigned long categoryId; (4)
unsigned long adId; (4)
unsigned long parentAssetId; (4)
unsigned long flags; (4)
VOD_Date dateAvailable; (16)
unsigned short yearOfRelease; (1)
unsigned char *description; (400)
unsigned long suspendedPosition; (4)
unsigned long rentalTimeRemaining; (4)
unsigned long viewingTimeRemaining; (4)
unsigned long runTimeRemaining; (4)
}VOD_VideoInfo;

Total = 566
```

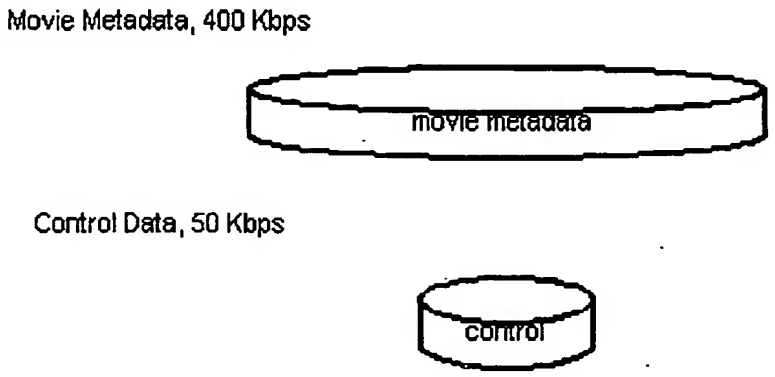
Mathematically then, a 500 movie database would contain a maximum:

```
566 bytes x 500 = 283,000 bytes
```

Not all movies will require the complete metadata record space. In fact, a typical movie metadata record would consume less than ½ of the available record space. (Note that in any case sending more metadata requires more bandwidth and/or greater latency while the client receives the data.) Our carousel solution fits both equations, providing the appropriate solution for the specific customer requirements.

Even at lower bitrates the DCT2000 drops DC2TEXT messages and so the carousel(s) must loop often. The ODA client will simply tune to different IB-DC2TEXT program streams to access different metadata elements.

Figure 3-5: Metadata Carouseling



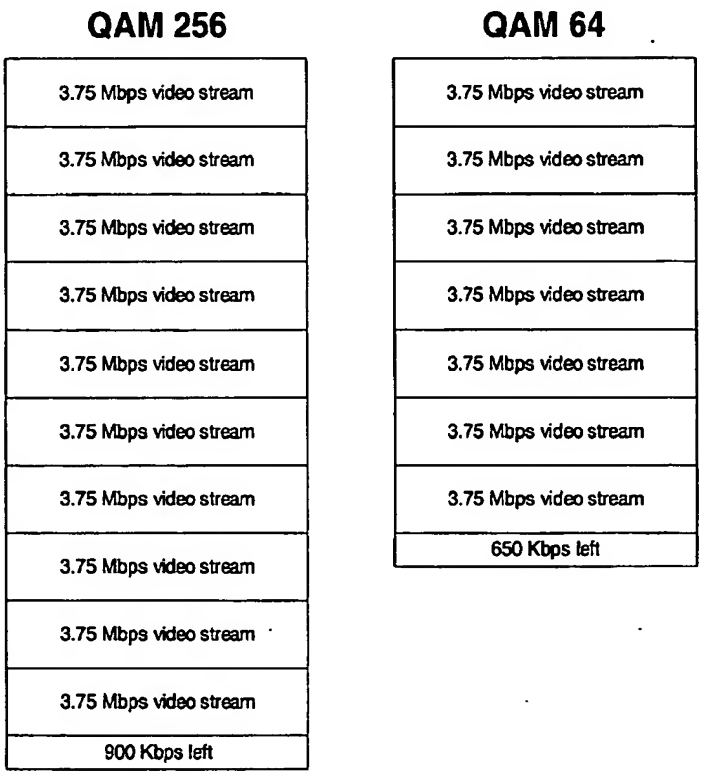
The Plant ID carousel contains a non-metadata element that is used by the set-top box to "self-discover" its service group information.

Our experience streaming DC2TEXT IB to DCT2000s confirms that the DCT can process a range of nearly 0 bps to a maximum of about 400,000 bps. As the bitrate increases, the DCT's processor-powered features begin to bog down. Examples are IR-reader and front panel monitoring routines. Beyond 400 kbps the box usually resets itself or hangs. For a 500 movie library example with an average of 200 bytes of description metadata per asset streamed at 400 kbps, the carousel would loop every 2 seconds.

Currently, VOD service providers fill their QAMs with 3.75 Mbps video streams. This results in a maximum of 10 X 3.75 Mbps programs for QAM 256 and 7 X 3.75 Mbps programs for QAM64. To avoid stealing bandwidth from paying subscribers, all movie metadata, Plant ID, and control data must fit into a 900 Kbps window on a QAM256 plant and 650 Kbps on a QAM64 plant. The math:

```
QAM256: 38.4 mbps - (3.75 x 10) = 900 kbps
QAM64: 26.9 mbps - (3.75 x  7) = 650 kbps
```

Figure 3-6: QAM Bandwidth Usage



Chapter 4: System Communications

This chapter provides descriptions of the communication flow for VOD system events.

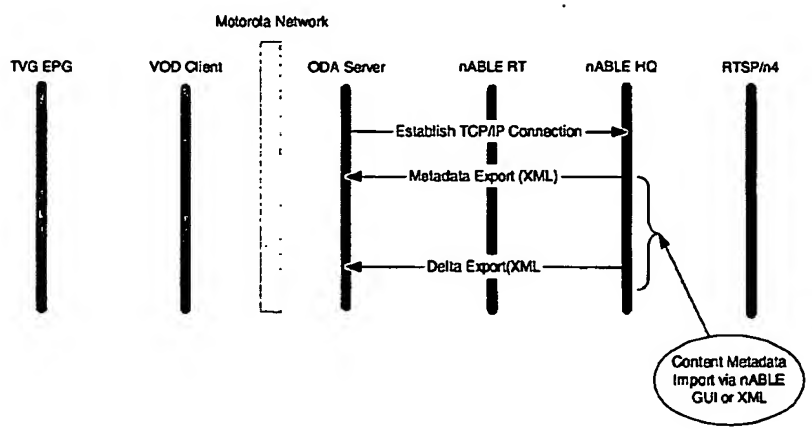
The VOD system event documented include:

- ODA Metadata Update
- Set-top Box Self Discovery
- TVG Interactive/nCUBE ODA Client Download
- Posting a Billing Event
- Session Setup - Buy Movie
- Session Setup - Resume Play
- Session Teardown - End of Stream, Pause Limit Reached, or Stop

ODA Server Subscriber Metadata Update

Trigger	Message	IB/ OOB	Type	Size	Notes
Update ODA Metadata Collection	On startup, ODA Server establishes TCP/IP socket with nABLE HQ	n/a	TCP		
	nABLE HQ sends complete Subscriber Metadata collection to ODA Server	n/a	TCP		
	At a configured interval or manually, nABLE HQ sends delta updates to the ODA Server	n/a	TCP		

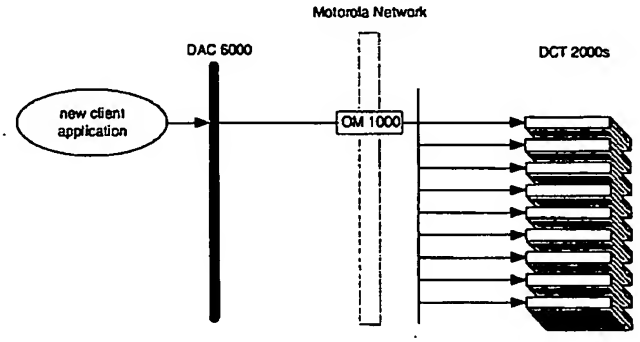
Figure 4-1: ODA Server Metadata Update



TV Guide Interactive/nCUBE VOD Client Update

Trigger	Message	IB/ OOB	Type	Size	Notes
The Client Application object is downloaded onto the onto the DAC 6000	DAC 6000 updates all DCT 2000s via multicast	OOB			

Figure 4-2: Client Updates on DCT 2000s



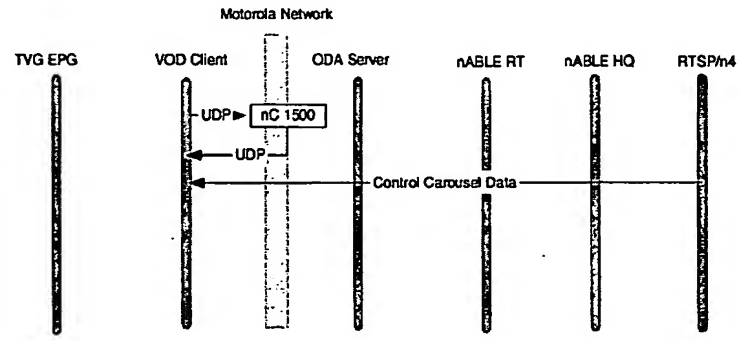
Set-top Box Self Discovery

For a detailed, technical description of the Plant ID self-discovery mechanism, see the System Administration section of this document.

Trigger	Message	IB/ OOB	Type	Size	Notes
The nCUBE Client Application boots	The ODA Client Application queries the NC 1500 hosts table using a by-name lookup for the IP address of the ODA Server.	OOB	QPSK		
	The NC 1500 sends the IP address.	OOB	QPSK		

Trigger	Message	IB/ OOB	Type	Size	Notes
	The ODA Client opens a socket and contacts the ODA Server requesting the virtual channel it should use to find the Plant ID carousel.	OOB	TCP		
	The ODA Server returns the VCN.	OOB	UDP		
	The ODA Client tunes the virtual channel(s) and looks for DC2TEXT messages in the carousel stream to self-discover its Service Group (Plant ID).	n/a	n/a		The client uses this PlantID data until (1) 48 hours passes or (2) the STB is powered off and (3) the client experiences errors in the VOD session .

Figure 4-3: Set-top Box Self Discovery

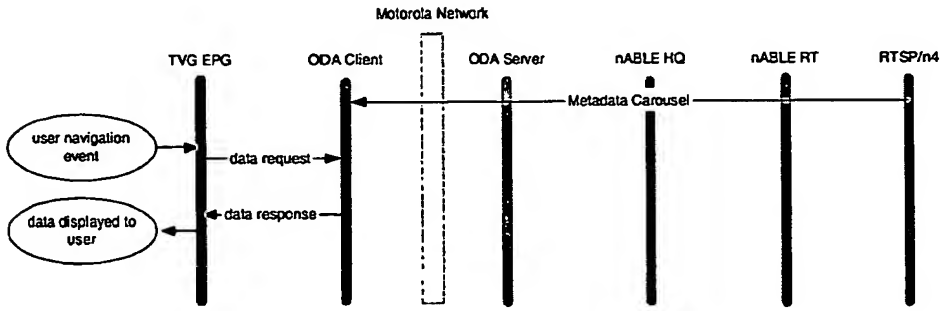


User Navigation

Trigger	Message	IB/ OOB	Type	Size	Notes
User navigates VOD User Interface and views static metadata	ODA Client pulls static metadata from the DC2TEXT Messages embedded in the IB Metadata Carousel.	IB	DC2T EXT		

Trigger	Message	IB/ OOB	Type	Size	Notes
	TV Guide makes request of ODA Client for metadata to provide the user with VOD information	n/a			
	ODA Client hands over the requested metadata.	OOB	UDP		
	TV Guide displays the VOD information to the user.	n/a			

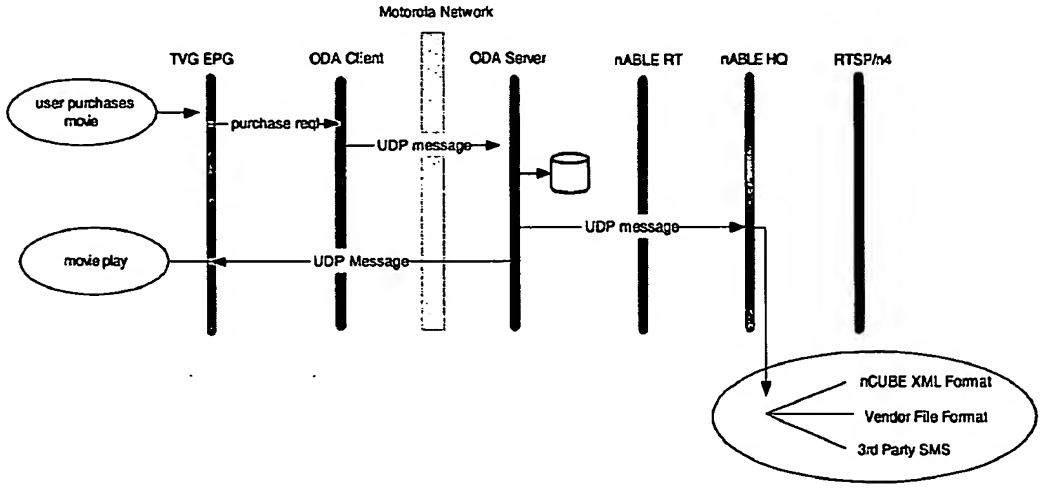
Figure 4-4: User Navigation Event



Posting a Billing Event

Trigger	Message	IB/ OOB	Type	Size	Notes
User Purchases a Movie	TVG notifies the ODA Client of a purchase request	n/a			
	ODA Client sends Purchase Request to the ODA Server	OOB	UDP		
	ODA Server checks if the movie is already purchased. (If the movie is already purchased, then ODA Server returns session information to the ODA Client.)	n/a	n/a		
	ODA Server sends the Billing Message via XML over TCP to nABLE HQ	n/a	TCP		
	nABLE HQ outputs the appropriate format: 1. Vendor-specific file format 2. Message to vendor billing system 3. nCUBE XML File Format	n/a	TCP		
	ODA Server returns session information to the ODA Client.	OOB	TCP		

Figure 4-5: Posting a Billing Event

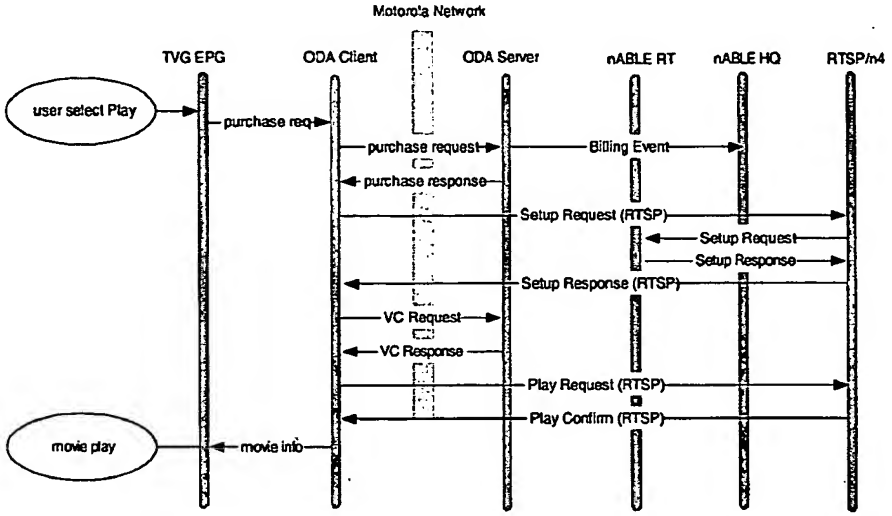


Session Setup - New Purchase

Trigger	Message	IB/ OOB	Type	Size	Notes
The User selects purchase movie	The TVG EPG issues a Purchase Request to the ODA Client.	n/a	n/a		
	ODA Client sends the purchase request to the ODA Server.	OOB	UDP		
	ODA Server handles the purchase, communicates with the nABLE billing server and returns session info to the ODA Client necessary to set up the movie	OOB	UDP		
	The ODA Client sends a Session Setup Request to the RTSP server.	OOB	RTSP		
	The RTSP Server assigns a session ID and sends the request to nABLE RT.	OOB	RTSP		

Trigger	Message	IB/ OOB	Type	Size	Notes
	nABLE RT assigns the Pump ID and Transport ID (TSID) for the session and sends these to the RTSP server.	OOB	RTSP		
	The RTSP Server sends the TSID and Service Group ID to the ODA Client.	OOB	RTSP		
	ODA Client sends TSID and SGID to the ODA Server requesting the virtual channel number (VCN) the movie is playing on.	OOB	RTSP		
	ODA Server returns VCN for the session to the ODA Client	OOB	RTSP		
	ODA Client submits play command to RTSP server	OOB	RTSP		
	RTSP Server sends confirmation message and begins to stream the session	OOB	RTSP/ MPEG -2		
	ODA Client attempts to tune to the VCN and notifies TV Guide to begin the session	n/a	n/a		
	TV Guide client removes the EPG user interface and shows the movie (fail case = error message)	n/a	n/a		The MPEG file includes the Transport Heartbeat which acts as a Keep Alive mechanism during the video stream.

Figure 4-6: Session Setup

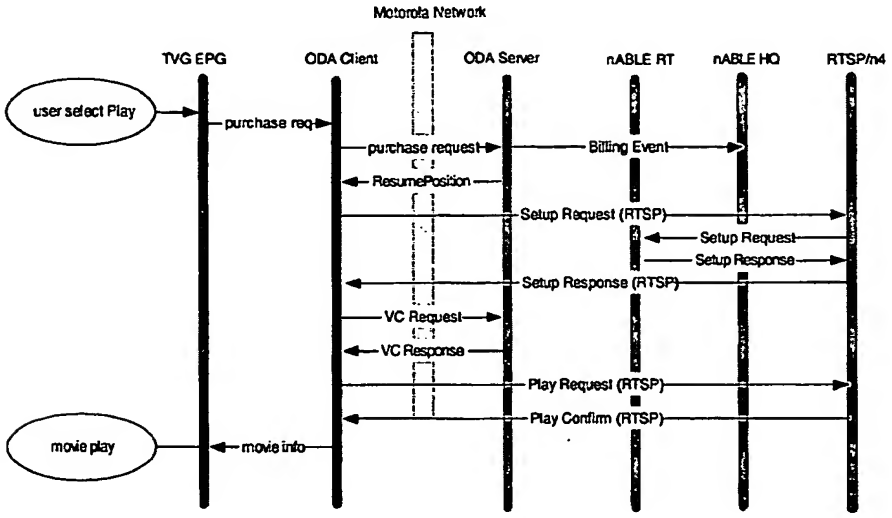


Session Setup - Restart/Resume Playing a Checked Out Asset

Trigger	Message	IB/ OOB	Type	Size	Notes
The user selects a checked out title from the TVG EPG	The TVG EPG notifies the ODA Client of a purchase request to restart or resume a movie.	OOB	n/a		
	ODA Client sends the purchase request to the ODA Server.	OOB	UDP		
	ODA Server handles the purchase via the billing service and returns session info including the last known position (ResumePosition), which the ODA Client uses to set up the movie.	OOB	UDP		
	The ODA Client sends a Session Setup Request to the RTSP Server.	OOB	RTSP		

Trigger	Message	IB/ OOB	Type	Size	Notes
	RTSP Server assigns a Session ID and requests a session with nABLE RT.	OOB	RTSP		
	nABLE RT assigns an output ID to the session including TSID and server topology information, and passes TSID to the RTSP Server.	OOB	RTSP		
	RTSP Server sends RTSP Session Setup response with session ID and TSID to the ODA Client.	OOB	RTSP		
	ODA Client sends TSID and SGID to the ODA Server requesting the virtual channel number (VCN) the movie is playing on.	OOB	RTSP		
	ODA Server returns VCN for the session to the ODA Client	OOB	RTSP		
	ODA Client submits play command to RTSP server	OOB	RTSP		
	RTSP Server sends confirmation message and begins to stream the session	OOB	RTSP		
	ODA Client attempts to tune to the VCN and notifies TV Guide to begin the session	n/a	n/a		
	TV Guide client removes the EPG user interface and shows the movie (fail case = error message)	n/a	n/a		The MPEG file includes the Transport Heartbeat which acts as a Keep Alive mechanism during the video stream.

Figure 4-7: Session Setup - Resume Playing a Checked out Title

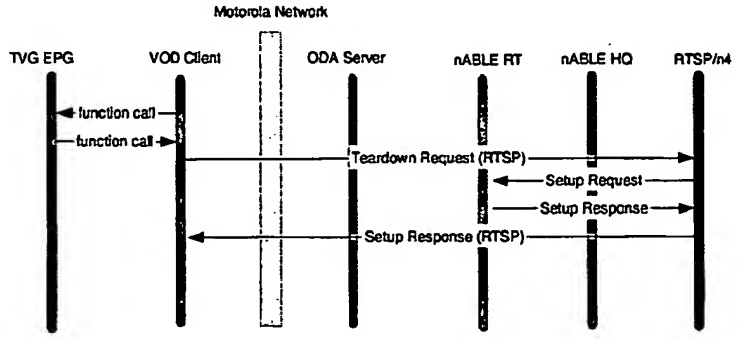


Session Teardown

Trigger	Message	IB/ OOB	Type	Size	Notes
End-of-Stream reached, pause limit reached, or user select Stop on the remote control.	In the case of End-of-Stream or pause limit reached, the ODA Client application asks TVG to end the session. TVG displays the Guide UI to the user. In the case of user selecting Stop on the remote control, TVG requests session teardown from ODA Client and displays the Guide UI to the user.	OOB	n/a		
	ODA Client sends Session Teardown Request to RTSP Server	OOB	RTSP		
	RTSP Server sends Session Teardown Request to nABLE RT	OOB	RTSP		

Trigger	Message	IB/ OOB	Type	Size	Notes
	nABLE RT deallocates bandwidth and sends Session Teardown Response to RTSP Server	OOB	RTSP		
	RTSP Server sends Session Teardown Response to ODA Client	OOB	RTSP		
	RTSP Server sends Session Teardown Request to nABLE RT	OOB	RTSP		
	nABLE RT sends Session Teardown Response to RTSP Server	OOB	RTSP		
	RTSP Server sends Session Teardown Response to ODA Client	OOB	RTSP		
	ODA Client sends last known position (ResumePosition) to the ODA Server	OOB	UDP		
	The ODA Server sends a confirmation to the ODA Client.	OOB	UDP		

Figure 4-8: Session Teardown - End of Stream



Chapter 5: System Administration

This section contains information of interest to system administrators including:

- Plant ID
- Transport Heartbeat
- nCannon Configuration
- Catcher's Mitt Configuration
- System Administration

The administration of the TV Guide solution is primarily the administration of the content that is offered in the service.

Most system administration tasks are documented in detail within a system component's respective product manuals. This section serves as an administrator's reference for the solution as single integration. For specific information for a system component, see the documentation for that component.

In certain cases, such as server administration, this document reproduces the documentation found elsewhere in the document set, in order to provide system administrators with a useful reference.

Plant ID

Plant ID is the set-top box self-discovery mechanism that enables VOD clients to self-report their Service Group (Plant ID) information to the headend VOD system. nCUBE has applied for a patent for its Plant ID mechanism.

How does Plant ID work?

When TV Guide Interactive sends a message notifying the ODA 2.1.1 Client to begin a VOD session, the ODA 2.1.1 Client starts the *gain focus* process. The first step in the ODA 2.1.1 Client *gain focus* process involves self-determining its Plant ID.

The ODA 2.1.1 Client use the ODA 2.1.1 Server hostname stored in the NC 1500 to send a message to the ODA 2.1.1 Server requesting the list of Plant ID Scan Channels the ODA 2.1.1 Client can use to find its Plant ID. Once the list of channels is returned and set up, the ODA 2.1.1 Client sequentially tunes through the list of Plant ID Scan Channels. For each Plant ID Scan Channel successfully tuned, the ODA 2.1.1 Client requests a list of all component streams on that channel.

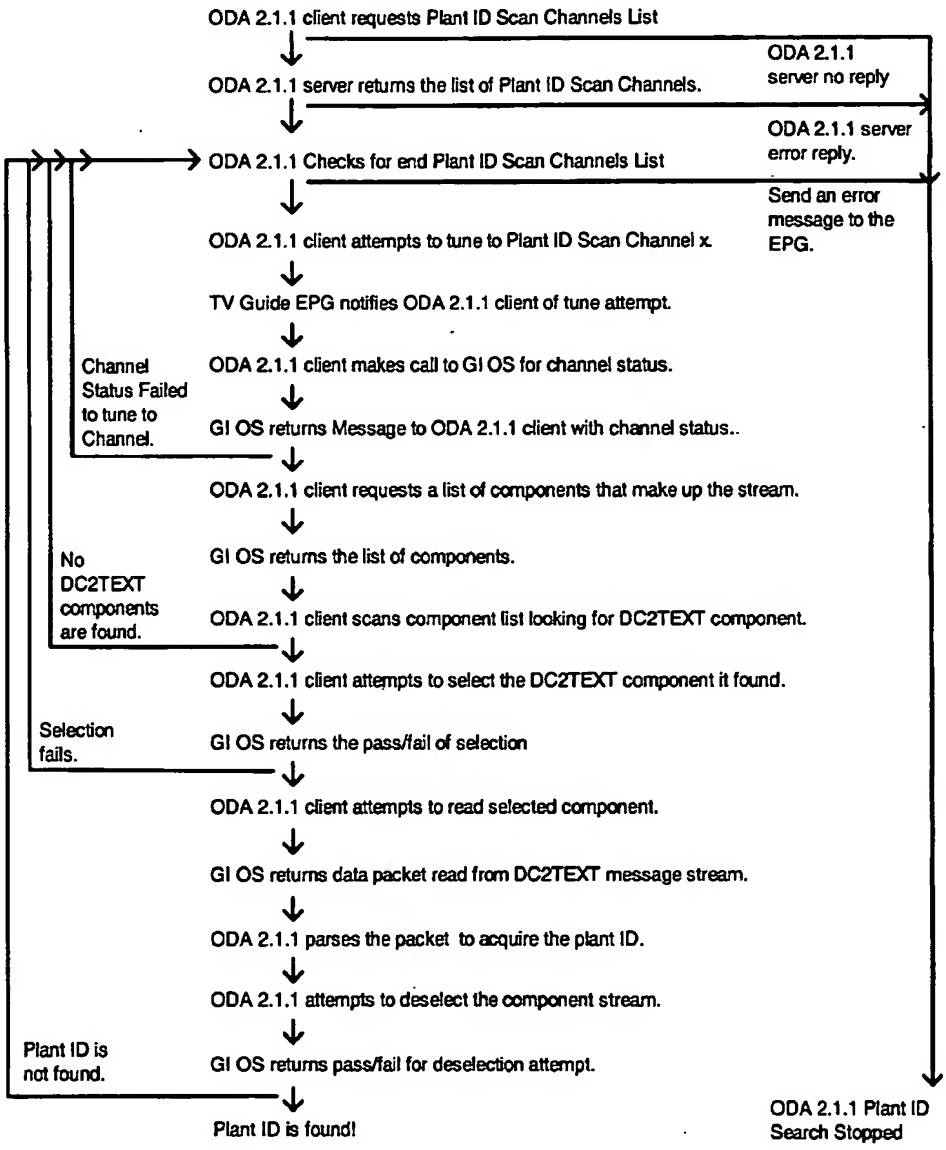
Once the list of streams is returned, the ODA 2.1.1 Client will search the list for a DC2TEXT message stream. If a DC2TEXT message stream is found, the ODA 2.1.1 Client selects the stream for reading and attempts to extract a DC2TEXT message

packet from the selected stream. Upon receiving the DC2TEXT message packet, the ODA 2.1.1 Client parses the packet and determines if its payload contains a Plant ID. If a Plant ID is correctly extracted from the DC2TEXT message packet, the ODA 2.1.1 Client stops the search and sends the Plant ID to the ODA 2.1.1 Server with a request for a list of all RTSP Servers available to ODA 2.1.1 Clients with the reported Plant ID.

The ODA 2.1.1 Client continues to use its dynamically acquired Plant ID for a configured amount of time (typically 48 hours) or until the ODA 2.1.1 Client experiences an application error that resets the Plant ID Acquisition Flag. If the Plant ID Acquisition Flag is reset, Plant ID acquisition will take place on the next begin session message from the TV Guide EPG.

The Plant ID self-discovery process is illustrated in Figure 5-1.

Figure 5-1: Plant ID Self-Determination



Configuring Plant Str am ID

1. Use nABLE to add a service group with the plant name. (See the nABLE online documentation for details on how to add a service group.)

   As an example if the plant name is "12345" the service group would be defined to be "12345" in the nABLE user interface.

   The name and the service area could be the same and the plant file does need to exist on the cube.

2. Next you must define the video transport for each service group to enable the auto discovery function. To do this, use the *Database Viewer Utility* (DBV) to define the video transport for each service group.

   First, run DBV.

```
cd /usr/ncube/lib

java -jar ./dbv.jar
```

3. Using DBV, connect to the database as the vodhq user for the HQ database.

   Enter the following connection settings:

User	vodhq
Password	<oracle db password>
Hostname	<IP Address or Hostname of HQ/RT server>
Port	1521
SID	vod

   Select **OK**.

4. Expand the DBV window, and from the left-hand column select the **PLNT_PLANT_INFO** table.

   Write down the **plant_id** and **plant name** for all available Service Groups. (These service groups you defined during the Service Group configuration through the nABLE GUI.)

5. From the left-hand column select the **PVTI_VIDEO_TRANS_INFO** table.

6. Enter an entry for each Service Group plant_id recorded by double-clicking the empty row in the PLANT_ID column.

7. Enter the first plant_id that you wrote down above.

8. Double-click the empty cell in VIDEO_TRANS column and define the Video Transport using the following format:

   CIM Board: MP2T/DVBC/QAM;unicast;destination=<board name>:<connector>.<program number>

The following example would run the same plant streams on 3 different program numbers:

```
PLANT_ID     VIDEO_TRANS

10262
MP2T/DVBC/QAM;unicast;destination=cim0014:1.12

10262
MP2T/DVBC/QAM;unicast;destination=cim0014:1.11

10262
MP2T/DVBC/QAM;unicast;destination=cim0014:1.13
```

9. Single-click the cell to the left, then right-click and select **Insert**.
10. Repeat these steps for each static session that you are defining for this installation.
11. Select **Commit** in the lower left corner of the DBV screen
12. Select File > Close > Exit.

Note: The HQ process must be restarted for database changes to take effect.

Transport Heartbeat

The transport heartbeat mechanism provides resume functionality and a reliable means for the client to detect end-of-stream and stream errors.

How does Transport Heartbeat Work?

Transport Heartbeats are specifically formatted DC2TEXT messages that are embedded into movie content at tag time on the n4 video server. These Transport Heartbeat DC2TEXT messages contain information relating to the current position of the video file.

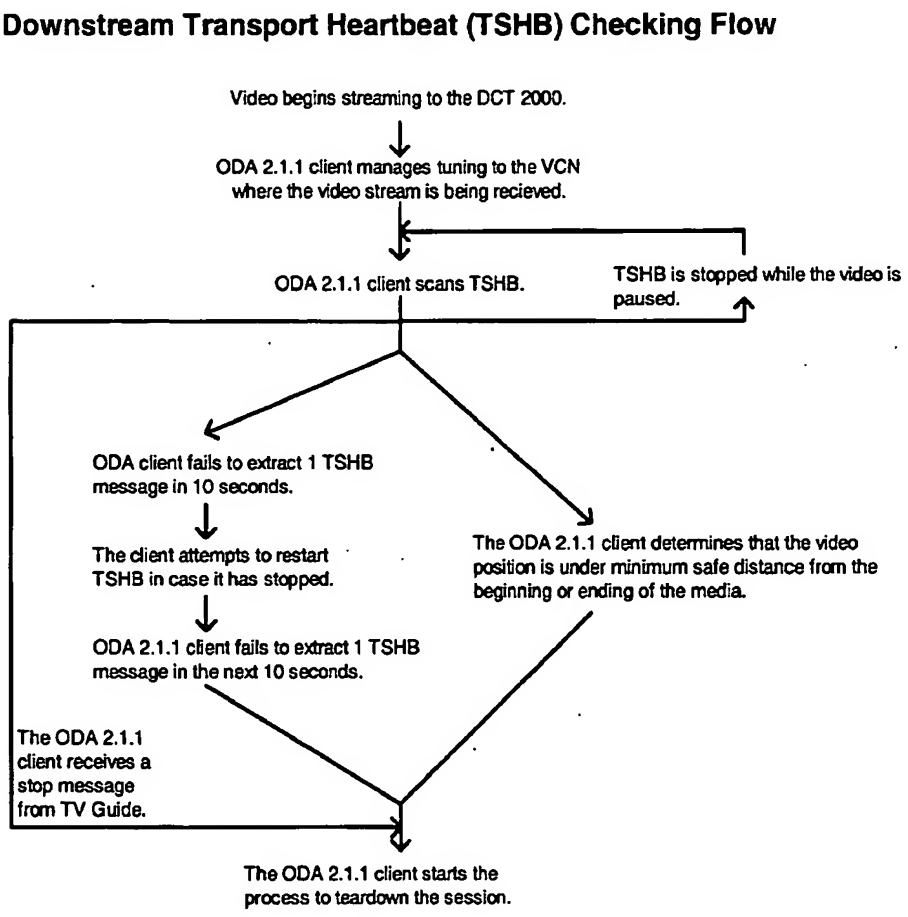
The ODA 2.1.1 Client uses transport heartbeat message for three reasons:

1. Transport Heartbeat messages report the customer's current position in the media. When the session is terminated, the last acquired media position is stored in the ODA 2.1.1 Server so that the user can later resume the media from this last known position.
2. The ODA 2.1.1 Client uses Transport Heartbeat messages to ensure a constant stream of media is entering the set-top box and being displayed to the user. If for some reason the media flow to the set-top box is interrupted for a pre-defined length of time, the ODA 2.1.1 Client will teardown the session and return the customer to the TV Guide Interactive User Interface.

3. The media position the ODA 2.1.1 Client extracts from Transport Heartbeat is used to determine the media position relative to the beginning and ending of the media. This allows the ODA 2.1.1 Client to prevent the user from running over either end of the media during a session.

Figure 5-2 illustrates the Transport Heartbeat mechanism.

Figure 5-2: Transport Heartbeat



nCannon Configuration

nCannon will emulate X number of RTSP UDP Set-top boxes where X is < 200. nCannon will set up X number of streams, wait for Y milliseconds, then tear those X streams down. Setups will be sent out at 10 per second. Teardowns will be sent out at 10 per second. An output(Date).csv will be created for each run of nCannon that contains timing and status information on commands being sent.

nCannon requires jdk1.3 be installed. nCannon uses a configuration file (**cann n.ini**) that contains two sections requiring configuration:

- RTSP
- Script Generation

The RTSP Section is as follows:

```
[RTSP]
mode=udp
RTSPServerPort=590
CannonUDPPort=5556
RTSPServerIP=134.242.101.52
RTSPServerWithoutnABLE=false

#IP via UDP = MP2T/H2221/UDP
#IP via TCP = MP2T/H2221/TCP
#DAC = MP2T/DVBC/ASI
#CIM=MP2T/DVBC/QAM
#ATM=MP2T/H2221/AAL5-PVC
Transport=MP2T/DVBC/ASI

ServiceGroupCount=1
#Must match plant name in nABLE (case-sensitive)
ServiceGroupName0=MyPlant0
ServiceGroupRange=1000
MayNotify=false
PlayNow=false
Loop=false
```

In this section you need to change the following:

- RTSPServerPort needs to match the port number of the RTSP Server running on the n4
- RTSPServerIP needs to match the IP address of the n4 where the RTSP Server is running
- Transport needs to contain the means of transport of the video stream. Valid choices are located in the RTSP section.
- ServiceGroupCount should be set to the number of service groups that are configured in the VideoServer in the nABLE GUI
- ServiceGroupName0 needs to match the name of the Service Group defined in the nABLE GUI
- ServiceGroupRange: After how many setups do you want to switch over to the next service group?

The Script Generation section is as follows:

```
[ScriptGeneration]
RandomMediaSelectionMode=true
NumberOfMovies=1
Title0=/mds/nvision1/dcut3.mpi
BitRate0=3000000
#Number of Setups must be 10, 100, or 200
SetupCount=10

#Amount of time to wait before tearing down the sessions
(in milliseconds)
InterspersedTime=900000
```

In this section you will need to change the following:

- RandomMediaMode: Should the movies listed below be selected at random or sequentially
- NumberOfMovies: How many movies do you want to be able to choose from when generating setup messages
- Title0: title of the first movie and must include full volume information
- BitRate0 bitrate of first movie
- SetupCount: How many movies to set up
- InterspersedTime: How long should the pause be between finishing the last setup request and starting the teardowns?

To run nCannon type "runCannon" on Solaris boxes, or "runCannon.bat" on a Windows machine.

Catcher's Mitt

nABLE supports importing content and metadata using the workflow described in the ADI 2.0 specification based on the 1.2.2 ISA IDL. nCube has tested nABLE 1.6.2 against the N2BB Catcher's Mitt on a limited scale. nCUBE does not have a pitcher; therefore, satellite delivery of content was not tested, nor was automated delivery of content tested.

There are several issues to note concerning the current Catcher's Mitt implementation:

- Due to limited nature of vsviewgen being only able to tag one file at a time, multiple packages cannot be exported from the Catcher's Mitt simultaneously with full assurance of successful export.
- nCUBE did not test exporting a package that had no associated content using the Catcher's Mitt.

- nABLE does not currently have the capability to connect to multiple NamingServices. nCUBE assumes that the NamingService will be provided on the Catcher's Mitt.

Configuring Catcher's Mitt

nABLE needs to be configured in order to support moving assets from the Catcher's Mitt to the n4 and having the metadata be imported into the ODA.

The following configuration steps need to be followed.

1. Using the nABLE UI, configure a NamingService that points to the Catcher's Mitt using port 5000. (For details on configuring Naming Services in nABLE, see the online documentation.)
2. Using the nABLE UI, configure a FileService under the nABLE RT of type nVS that points to the n4 where content from the Catcher's Mitt is to be sent. Make sure the DestinationIPForMpegs property in the ISA section of the **skyhq.ini** file contains the same ip address as the new file service. Note that this file service does not need to be a staging file service.
3. Using the nABLE UI, configure the ODA. Make sure the ODAName and ODASID are configured in the ISA section of **skyhq.ini** file to match the information of the ODA you've created.
4. Choose where the destination volume of where content (MPEG Files) should be placed on the n4 video server by setting the DestinationVolume property found in the ISA section of the skyhq.ini file.
5. Choose where the destination volume of where content (images) should be placed on the HQ by setting the DestinationDirectoryForImages property found in the ISA section of the **skyhq.ini** file.
6. Determine whether or not you want to tag in single asset or multiple asset or mode. If multiple asset mode then set the multiple asset switches.
7. Make sure EnableIsa in the ISA section of the skyhq.ini file is set to true.
8. Either start, or restart nABLE HQ.

You can turn off the Catcher's Mitt capability by setting the EnableIsa in the ISA section of the **skyhq.ini** file to false. If a NamingService is not properly configured and you have EnableIsa = true, the HQ will not start.

Figure 5-3: Sample skyhq.ini file

```
[Isa]
#The orb nor any of the Isa facades will run if set to
false
EnableIsa = true
#Equals the name of the orb settings section to use
OrbName=Jacorb
```

```
#Size of chunks when splitting up an IOR for storage in
the db
IorSegmentSize = 4000
EnablePackageFactory=true
PackageFactoryName = PackageFactory
HQPackageStorageDirectory = /usr/ncube/package/
ODASID=
ODAName=
ExportToQA=true
ExportTOSub=false
DistributeToProductionN4=true

#IP address of a file service configured in nABLE that
corresponds to a nVS n4
DestinationIPForMpegs=0.0.0.0

#Where mpeg content should be placed
#If this value is "mostspace", the volume with the
greatest space will be used.
#Otherwise specify the actual volume (note this value is
only used in the ADI workflow)
DestinationVolume=/mds/nvision1

#Where on the HQ the images are destined for
DestinationDirectoryForImages=/usr/ncube/bfs

#Whether the tagging procedure in the ADI workflow should
use vstag or vsviewgen
SingleAsset=false

#Multiple Asset Configuration Parameters
#for DCT2000 STBs use -t -a ac3
Switches=-t
NumberOfRates=2
Rate0=7
Rate1=-7
[Isa Done]
```

System Administration

This section describes basic system administration tasks for the following components:

- ODA 2.1.1 Client
- ODA 2.1.1 Server
- n4 Video Server
- nABLE
- nVS

ODA 2.1.1

Starting and Stopping ODA Services

There are three (3) startup scripts located in **/usr/local/oda/bin**. These scripts start, restart and stop the Metadata Receiver Service (MRS), the Billing Post Service (BPS), and the Broadband Communications Service (BCS).

To start or restart MRS, from /usr/local/oda/bin enter:

```
./mrs start|stop|restart
```

To start or restart BPS, from /usr/local/oda/bin enter:

```
./bps start|stop|restart
```

To start or restart BCS, from /usr/local/oda/bin enter:

```
./bcs start|stop|restart.
```

Configuring VOD Categories

While nABLE 1.6.2 supports nested categories, the ODA MRS does not. As a workaround, the ODA Server has a **bcs.properties** file that allows for the configuration of Main Level categories (New Releases, Last Chance, All Videos, and Categories) as well as subcategories (Action, Comedy, Drama).

The **bcs.properties** file defines the Main Level categories as well as the TopCategory, which is the Main Level category that contains subcategories. An example of the file is shown in

Figure 5-4: bcs.properties file

```
########################################
# top level 'Main Menu' TVG Categories
MainMenu[0].CategoryName=New Releases
MainMenu[1].CategoryName=Last Chance
MainMenu[2].CategoryName=Categories
MainMenu[3].CategoryName=All Videos
```

```
# all non Main Menu categories have a parent id of this
category
TopCategory=Categories
##########################################
```

Main Level Categories

To add, edit, or delete Main Level Categories, you need to modify the **bcs.properties** file located in **/usr/local/oda/etc/config** before starting ODA Server 2.1.1.

To **add a new Main Level category**, insert a new line in the file:

`MainMenu[1].CategoryName=`*`New Category`*

where *New Category* is the name of the category you are adding.

Next, add the new category to your ODA collection in nABLE and export to subscribers. See the nABLE online documentation for details.

To **edit a Main Level category**, change the CategoryName to the new category:

`MainMenu[1].CategoryName=`*`New Category`*

where New Category Name is the category name you are changing to.

Next, add the new category to your ODA collection in nABLE and export to subscribers. See the nABLE online documentation for details.

To **delete a Main Level** category, delete the line for that category from the file.

`MainMenu[1].CategoryName=`*`Category`*

where *Category* is the name of the category you are deleting.

Delete the category in your ODA collection in nABLE and export to subscribers. See the nABLE online documentation for details.

Subcategories

Edit the categories for your ODA collection with nABLE HQ. For details on how to edit categories in nABLE, see the nABLE online documentation.

ODA 2.1.1 Client

To activate the VOD UI while receiving TV Guide data via the HITS feed or LFG, press the Menu Key on the DCT 2000 remote control, and then select VOD from the TV Guide Interactive menu.

When in an environment without TV Guide data, the client application can be started by using the remote control to enter the sequence B-A-A.

n4 Video S rver

Restarting an n4 Server

Restarting an n4 server is a "warm reboot" that stops all programs and restarts Transit.

1. From a separate window, set up a serial connection to the root hub so you can watch reboot messages.
2. From nSM, click **Start/Stop | Reset n4.**
3. If you're not already logged in, log in as **ncubesys.**
4. Click **OK** to begin the reset.

After a restart you will need to also restart any application programs such as the nCUBE Video Server (nVS).

nABLE

Start nABLE

1. Log on as the user **ncube**
2. Stop and restart the Web server:

   pssky

   You'll see a line similar to

   `Webserver: 12345`

3. Kill the webserver by entering:

   kill -9 ***12345*** `(where 12345 is the number associated with Webserver)`

4. 3. Restart the web server:

   skyweb.sh &

5. Start the headquarters process.

   cd /usr/ncube/sbin

   ./skyhq.sh &

6. Start the nABLE RT Server (also known as headend) with the skyhe.sh script located in /usr/ncube/sbin.

   cd /usr/ncube/sbin

   ./skyhe.sh &

nVS

Starting, Stopping, or Getting Status on nVS via nSM

1. From nSM, click System Maintenance | Telnet.
2. If you are not already logged in, log in as nvs with the appropriate password.

3. You can start nVS processes with the command:

```
ncube4-0% nvsstart.all
```

4. You can stop nVS process with the command:

```
ncube4-0% nvsstop.all
```

5. You can get the status of nVS processes with the command:

```
ncube4-0% nvsstat

Collecting nVS process status spanning all configured
nodes NODE COUNT SIZE STATE ENTRY PROGRAM
0 1 464K running mnaddr mnaddrsrv
0 1 608K running orb mnrpcnmsrv
0 1 896K running orb mnorbsrv
0 1 640K running orb mnnmsrv
0 1 912K running log mnlogsrv
0 1 768K running errchan yeced
0 1 1552K running csm vscsmsrv
0 1 15264K running mds mdsdirsrv
0 1 8560K running strm vsstrmsrv
0 1 114880K running vspump vspump
0 1 6160K running cont vscontsrv 0 2 1952K running
rtsp rtspsrv
0 1 1792K running rtsp vsrtspsrv 0 1 6208K running ftp
mdsftpsrv
0 0 0K down snmp nvs_mole
ncube4-0%
```

Starting and Stopping nVS using the Command Line

To use the rc-shell command line to monitor and manage nCUBE Video Server, first open a telnet window on the n4 server.

1. From the nCUBE Server Manager menu tree, click System Maintenance | Telnet to open a telnet window.
2. When the user prompt appears, enter nvs and the administrator password (by default the same as the ncubesys password). The password does not echo.

```
user: nvs
password:
ncube4-0%
```

Starting nCUBE Video Server from the rc-shell Command Line

To start nVS, execute the nvsstart.all script.

```
ncube4-0% nvsstart all
```

nvsstart.all starts running nVS, executing all the programs identified in the nvs.config file.

Starting Selected or Additional Programs

To start the server with only selected programs, enter the following command:

```
ncube4-0% nvsstart alias1 alias2 [...]
```

where alias1 and alias2 are aliases defined in the nvs.config file. Each alias represents one or more processes. Note that some processes have ìdependenciesî.

Defined in the nvs.config file, these are other processes that must be running before a process can start. The system will check if they are running. If they are not, the system will start them, then start the process you invoked with nvsstart.

For example, to start just the MDS system and its dependencies, enter this command:

```
ncube4-0% nvsstart mds
```

Starting and Stopping nVS using the Command Line

You can enter one or more options after the script and before the alias(es). See the "Command Options" section in this chapter for a complete list and explanation of these options.

Stopping nCUBE Video Server from the rc-shell Command Line

1. If you have not already done so, open a telnet window to the boot node of the n4 system, and log in using the nvs account.
2. Execute the script nvsstop:

   ```
   ncube4-0% nvsstop all
   ```

   nvsstop.all stops all the nVS programs listed in the nvs.config configuration file.

Stopping Selected Programs

To stop only specific programs, enter the command:

```
ncube4-0% nvsstop alias1, alias2 [...]
```

where alias1, alias2 are aliases defined in the nvs.config file. Each alias represents one or more processes to be stopped

Note: nCUBE strongly recommends starting nVS server processes with the supplied nvs.config file and nvsstart all script. If you need to modify these files from those created at installation, create backup copies of each file and modify the parameters in the script.

Glossary

The Glossary is where to turn when you have questions regarding the meaning of a term or its usage. This glossary includes terminology related to the cable industry, telecommunications, video on demand.

A

ADC (Analog-to-digital conversion)
An electronic process in which a continuously variable (analog) signal is changed, without altering its essential content, into a multi-level (digital) signal.

ADSL (Asymmetrical Digital Subscriber Line)
A technology for bidirectional digital transmission on standard twisted-pair copper phone lines used for consumer TV applications with "VCR-like" quality.

Analog Video
A non-digital video signal used by most conventional video equipment for input or output. Video in which all the information representing images is in a continuous-scale electrical signal for both amplitude and time. Three basic analog video formats exist: NTSC, PAL and SECAM. (See separate entries for more detailed information.)

API
The specific language and message format used by an application program to communicate with an operating system or another application program such as a database management system (DBMS) or communications protocol.

Artifact
In video systems, something distorted or unintended observed in the reproduction of an image by the system. Flaws in a picture, such as cross-color artifacts, cross-luminance artifacts, jitter, blocking, ghosts, etc.

Asset
In a VOD system, when a cable operator enters metadata information into a database about a movie. Typically done through an application such as nABLE.

Asynchronous
Processes that proceed independently of each other until one process needs to "interrupt" the other process with a request. Using the client-server model, the server handles many asynchronous requests from its many clients. The client is often able to proceed with other work or must wait on the service requested from the server.

Asynchronous Transfer Mode (ATM)
High-speed, packet-switched and multiplexed switching technique for the efficient transmission of voice, data and video. Transmission format uses packets

of a fixed length of 53 bytes. A peak throughput of 155 Mbps or 622 Mbps is available for OC-3 and OC-13 installations, respectively.

B

Back Channel
Communications link used by the client to send video stream control commands (such as fast forward or play) to the server.

Bandwidth
Communications capacity of a specific path or transmission line through a network, measured in bits per second (bps). Refers to the frequency range transmitted by an analog system. In video systems, specifying the highest frequency value is sufficient, since all video systems must transmit frequencies down to 30 Hz or lower.

Baseband
Bandwidth characteristic of networks occupied by a single digital signal, such as Ethernet or Token Ring LANs.

Baud
The prevalent measure for data transmission speed until replaced by a more accurate term, bps (bits per second). One baud is one electronic state change per second. Since a single state change can involve more than a single bit of data, the bps unit of measurement has replaced it as a better expression of data transmission speed.

Bit
The smallest unit of information in a computer. A bit has a single binary value, either 0 or 1.

Bit Assignment
In video compression, the process of creating the compressed data bit stream from the raw output of the compression algorithm.

Blocking
An artifact of visible discontinuities between adjacent blocks in a DCT-based compression. Often seen at high compressions.

Broadband
The sharing of multiple signals over the same bandwidth, accomplished simultaneously through the use of multiplexing (splitting) of the signal.

Broadband File System (BFS)
A Scientific Atlanta data carousel for sending information to STBs.

Buffer
A data area shared by hardware devices or program processes that operate at different speeds or with different sets of priorities. The buffer allows each device or process to operate without being held up by the other.

Bursty Traffic
Data transmission with low duty cycle; data in multiple periods of short duration.

C

Cable Modem

A device connected to or integrated in a PC that enables you to receive and request information from the Internet over your local cable TV line. Cable modems provide throughput of up to 27 Mbps with about 2.5 Mbps of bandwidth for interactive responses in the other direction. This bandwidth far exceeds that of the prevalent 14.4 and 28.8 Kbps modems and the up to 128 Kbps of ISDNs or even the much higher speeds (up to 8 Mbps) of ADSL telephone technology.

Carrier

1. A signal that carries modulation; 2. A provider of data carrying services.

Cell

A fixed-size packet of data, for example that found in ATM.

Client

Application running on a VOD customer's set-top box (STB) that communicates with a video server.

Client-Server

Distribution of computing responsibility between front-end and back-end programs. When multiple machines are used, a client-server architecture supports reduced network traffic and increased overall performance.

Clip

Additional video added to a movie such as commercials, trailers or previews.

Coaxial and Fiber-Optic Cable

A coax can provide 100 channels, each of which is effectively a 36 Mbps pipe. These can be broken down further into 12 x 3 Mbps MPEG-2 digital television channels thus giving a total of 1200 channels (plus spare capacity for control and management) as opposed to one on a twisted pair. (There are many variations on this calculation, but all indicate an enormous number of channels.) Likewise a fiber-optic cable can provide up to 150,000 times the capacity of a twisted pair.

Codec

1. In communications engineering, the term codec is used in reference to integrated circuits, or chips that perform data conversion. In this context, the term is an acronym for "coder/decoder." This type of codec combines analog-to-digital conversion and digital-to-analog conversion functions in a single chip. In personal and business computing applications, the most common use for such a device is in a modem.

2. The term codec is also an acronym that stands for "compression/decompression." A codec is an algorithm, or specialized computer program, that reduces the number of bytes consumed by large files and programs.

Coding

The process of representing a varying function as a series of digital numbers.

Compression

The translation of audio, digital data or video into a more compact form for storage and transmission. Computer algorithms and techniques such as ETSI,

G.722, JPEG or MPEG enable data content compression. A digital process that allows data to be stored or transmitted using less than the normal number of bits. Video compression refers to techniques that reduce the number of bits required to store or transmit images.

Container
Data package, found in SDH, which floats with respect to the payload area of STM frames.

Contract Entity
The supplier with whom the contract is negotiated.

Contract Term
The contract may last for a number of years and may be renewed. It must have a start and end date.

Content
Any form of source material: movies, games, news, images, sounds, etc. which will appear on the user's television or PC screen.

D

Dark Fiber
A fiber optic line without terminal equipment provided the operator, and without switching.

Decoding
The process of converting coded data into its original format.

Digital
Describes electronic technology that generates, stores and processes data in terms of two states: positive and non-positive. Positive is expressed or represented by the number 1 and non-positive by the number 0. Thus, data transmitted or stored with digital technology is expressed as a string of 0s and 1s. Each of these state digits is referred to as a bit and a string of bits that a computer can address individually as a group is a byte.

Digital Video
Video where all of the information representing images has been digitized, allowing it to be more flexible and rapidly manipulated or displayed by a computer.

DVB-ASI (Digital Video Broadcast-Asynchronous Serial Interface)
Output format used in the cable industry.

DTA (Digital Turnaround)
Digital turnaround (DTA) systems make it possible to place insertions directly into an incoming MPEG-2 encoded program in the digital domain without first decoding to baseband. A DTA system joins, or splices, broadcast events encoded at the broadcast origination point with locally encoded ads or content. (DiviCom)

DVB (Digital Video Broadcasting)

The European group that works on digital TV broadcasting standards based on MPEG. The group has more than 110 members and has issued standards for digital TV broadcasting on cable and satellite.

Digitizing

The process of converting an analog signal into a digital representation. With images, it refers to the processes of scanning and analog-to-digital conversion.

E

Encoding

The process of converting analog electronic signals into digital format for storage, manipulation and display by a computer. Audio capture boards, scanners, video frame grabbers, or a combination of these devises carry out content encoding.

Ethernet

The most widely installed local area network technology. Now specified in a standard, IEEE 802.3, Ethernet was originally developed by Xerox and then developed further by Xerox, DEC and Intel. An Ethernet LAN typically uses coaxial cable or special grades of twisted pair wires. The most commonly installed Ethernet systems are called 10BASE-T and provide transmission speeds up to 10 Mbps. Devices are connected to the cable and compete for access using a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol.

F

Fast Ethernet

Also called 100BASE-T provides transmission speeds up to 100 megabits per second and is typically used for LAN backbone systems, supporting workstations with 10BASE-T cards. Gigabit Ethernet provides an even higher level of backbone support at 1000 megabits per second (1 gigabit or 1 billion bits per second).

FDDI (Fiber Distributed-Data Interface)

A standard for data transmission on fiber optic lines in a LAN that can extend in range up to 200 km (124 miles). The FDDI protocol is based on the token ring protocol. In addition to being large geographically, an FDDI LAN can support thousands of users.

Fiber Channel

A technology for transmitting data between computer devices at a data rate of up to 1 Gbps (one billion bits per second).

Field

One of the two scans of a frame in interlaced scanning formats.

Flat Fee

The licensee pays an arranged amount to the supplier to make the title available to the subscribers for a given time period, regardless of the number of times the title is purchased.

Frame

1. A single image in video or film. PAL and SECAM use 25 frames per second to create the image and simulate motion, whereas NTSC uses 30 frames per second (fps); 2. A group of data bits organized according to a specified format. Considered a logical entity with control information for use in bit-oriented protocols; 3. The result of a complete scan of one image. In motion video, the image is scanned repeatedly, making a series of frames. Typical video frames comprise two interlaced field of either 525 lines (NTSC) or 625 lines (PAL/SECAM), and running either at 30 frames per second (fps) or 25 fps. Motion picture film runs at 24 fps.

Frame Grabber

A device that captures and stores one complete video frame.

Frame Rate

Measured in frames per second (fps), frame rate indicates the speed of frame display impressions on a monitor. Standard broadcast TV frame rates equal 30 fps in North America and 25 fps in Europe. Most Internet video streaming facilities offer a frame rate of 15 fps.

Frame Relay

Frame relay is a technology for transmitting data packets in high-speed bursts across a digital network encapsulated in a transmission unit called a frame.

Full Motion Video

Video displays shown at the broadcast frame rate of 30 fps for NTSC-original signals or 25 fps for PAL-original signals.

G

GAS

Guaranteed Addressable Subscribers

GBR

Guaranteed Minimum Buy Rate. A proportion of the subscriber base by box office category. It can be fixed or variable.

Genlocking

The process of synchronization to another video signal. It is required in computer capture of video to synchronize the digitizing process with the scanning parameters of the video signal.

Genre

The category that defines a movie, such as Action, Drama or Comedy.

Gbit/s (gigabits per second)

A digital transmission speed of billions of bits per second.

Gbps (gigabits per second or billions of bits)

A measure of bandwidth on a digital data transmission medium such as optical fiber.

Gigabit Eth rnet

A local area network (LAN) transmission standard that provides a data rate of 1 billion bits per second (one gigabit). Gigabit Ethernet is defined in the IEEE 802.3 standard and the first product versions of it are now available. Gigabit Ethernet is used as an enterprise backbone.

Gigabit LAN

A term for the increasing of the data transmission speed of a conventional LAN to nearly 1 billion bits per second. Efforts are underway to boost Ethernet and AnyNet types of LAN to the gigabit range.

Gigabyte

The measure of memory capacity that is "roughly" a billion bytes. A gigabyte is two to the 30th power, or 1,073,741,824 in decimal notation.

GME

Guaranteed Minimum Exposure.

GUI

A Graphical User Interface to an information system.

H

Headend

A cable company site, typically an unattended building that contains all the cable equipment needed to send cable signals to viewers' homes. The headend is where programming is aggregated and combined onto HFC for distribution to cable hubs.

HDTV

High-definition television; the idea of improved spatial resolution with an improved temporal resolution, improved color rendition, fewer artifacts, a wider aspect ratio, and multi-channel sound. Common name for several proposed standards for improved image quality.

HFC (Hybrid Fiber Coax)

A type of network that contains both fiber-optic cables and copper-coaxial cables. The fiber-optic cables carry TV signals from the headend office to the neighborhood; the signals are then converted to electrical signals and go to houses on coaxial cables.

High Bit Rate

Data streams of 1.5 Mbps or greater, providing 30 frames per second of full-motion video delivery (comparable to broadcast television quality).

Hz (Hertz)

A unit of electromagnetic frequency (of change in state or cycle in alternating current) of one cycle per second. Hertz (Hz) replaces the earlier term of "cycle per second (cps)." One kilohertz (kHz) is equal to 1,000 cycles per second.

Hypercube

2 or more nCUBE n4 video servers connected together. Provides scalability to a system.

I

I-Frame
The MPEG compressed video frame where redundancy between adjacent frames is not taken into account, only the information in a single frame is compressed. It is used in conjunction with the B (bidirectional) and P (predictive) frame encoding. If frames are lost during MPEG decoding, the decoder cannot fully recover until the next I frame comes along. The frequency of I frames in a sequence determines how long it takes to get a reasonable picture after a random access or loss of data.

Image
A still picture, or one frame of a motion sequence.

Image File
A file of data that represents an image.

Image Plane
Each memory array in digital video display hardware that has more than one video memory array contributing to the displayed image in real time.

Interactive TV
Enables viewers to interact with the television set in ways other than simply controlling the channel and the volume and handling videotapes. Typical interactive TV uses are selecting a video film to view from a central bank of films, playing games, voting or providing other immediate feedback through the television connection, banking from home and shopping from home.

Interactive Video
The fusion of video and computer technology. It denotes a video program and a computer jointly operated under the user's control. The interactive choices the viewer makes influence the manner in which the program unfolds.

Interactive Video Module (IVM)
The combination of a CPU card and NICs.

Interactivity
The ability of a user (or a computer) to control the presentation by a multimedia system, not only for material selection, but for the way in which material is presented.

Interframe Coding
Video coding that examines differences between frames.

Interlaced Scanning
The concept of splitting a TV picture into two fields of odd and even lines.

Intraframe Coding
Video coding within a frame of a video signal.

Inverse Multiplexing
The splitting of one (broadband) data stream into a number of independent data streams with lower bit rates and the subsequent combination of these separate circuits into one data stream.

ISDN (Integrated Services Digital Network)
A CCITT digital telecommunications standard developed to transmit high-bandwidth digital data, voice and video signals. Bearer channel (ISDN B) provides circuit-switched bandwidth in multiplex of 64 Kbps, while a 16 Kbps packet-switched data channel (ISDN d) is also available. Common interface packages include Basic Rate Interface (BRI), consisting of two 64 Kbps B channels and one D channel, and Primary Rate Interface (PRI), consisting of 24 channels, usually composed of 23 B channels and a single D channel.

ISO (International Organization for Standardization)
Founded in 1946, the leading international standards organization. Among its developed standards is Open Systems Interconnection (OSI), a suite of communication protocols used widely in Europe.

Isochronous
(From the Greek "equal" and "time"; pronounced "eye-SAH-krun-us") Signal delivery capability at a specified rate, suitable for continuous data such as full-motion video and voice. Pertains to processes that require timing coordination to be successful, such as voice and digital video transmission. A sound or picture going from a peripheral computer device or across a network into a computer or television set needs to arrive at close to the same rate of data flow as the source. In feeding digital image data from a peripheral device (such as a video camera) to a display mechanism within a computer, isochronous data transfer ensures that data flows continuously and at a steady rate in close timing with the ability of the display mechanism to receive and display the image data.

J

Jitter
Unwanted frequency or phase variations, such as rate variations of a data stream or phase noise of a carrier signal. Also called **Phase Jitter**.

JPEG
Abbreviation for "Joint Photographic Experts Group," a working party of the ISO-IEC Joint Technical Committee 1, working on algorithm standardization for compression of still images.

K

K (Kilo)
Informally, 1,000. Technically, 1,024, so 64K is actually 65,536.

Kb (Kilobit)
1,024 bits. Also kb.

KB (kilobyte)
1,024 bytes. Approximately equivalent to half a sheet of paper's worth of typing, double-spaced.

Kbit/s (kilobit per second)
A digital transmission speed of thousands of bits per second.

Kbps (kilobits per second)

In the United States, Kbps stands for thousands of bits per second and is a measure of bandwidth (the amount of information that can flow in a given time) on a data transmission medium such as twisted-pair copper cable or coaxial cable.

Kernel

The essential center of a computer operating system, the core that provides basic services for all other parts of the operating system. Typically, a kernel (or any comparable center of an operating system) includes an interrupt handler that handles all requests or completed I/O operations that compete for the kernel's services, a scheduler that determines which programs share the kernel's processing time in what order, and a supervisor that actually gives use of the computer to each process when it is scheduled. A kernel also may include a manager of the operating system's address spaces in memory or storage, sharing these among all components and other users of the kernel's services. A kernel's services are requested by other parts of the operating system or by applications through a specified set of program interfaces known as system calls.

Keying

In a video system, the process of inserting one picture into another picture under spatial control of another signal, called keying the signal.

L

Logical Content

Logical groupings in a database of movies + clips + content. Movie is stored in one place but can have different clips associated with it to form different logical content.

Licensors Share

Percentage of the actual sale price to the subscriber that is due to the licensor.

M

MDS

Media Data Store. Special storage area for video content on the nCUBE video server. Controlled by nVS. Accessed through nCUBE Server Manager or special "mds" UNIX commands.

MediaHUB

Trademarked term for a single nCUBE video server, which includes the motherboard, Havoc board, various I/O boards and hard disks. "Hub" is the generic term often used for MediaHUB.

Minimum Wholesale Price

The minimum price that the licensee can charge the subscriber for the VOD event.

MPEG

A standard way of compressing analog video into digital form. Consists of I-frames, B-frames and P-frames.

NVOD

Near Video on Demand. Video that is played according to a schedule. Does not allow for trick play as VOD does.

N

nVS

nCUBE Video Server. Software on the nCUBE video server that pumps video to clients.

P

P-Frame

Used in MPEG compression, a predictive algorithm calculates P-frames taking into account information that is common among adjacent frames: The P-frame predicts the difference between the current frame and the closest preceding I- or P-frame. P-frame is used with I- and B-frame encoding.

Packet

A packet is the unit of data that is routed between an origin and a destination on any packet-switched network. Files are broken into packets for ease of transmission.

Package

Subscription- or promotional-based container for one or more products. See Subscription Package and Promotional Package.

Packetized Data

Data such as that representing video that is segmented into small pieces that are, for example, wrapped, labeled, numbered, addressed, error protected so as to survive transit through a heterogeneous or hostile environment; the small pieces are reassembled on completion of their journey.

PAL

Acronym for "Phase Alteration Line," which is the key feature of the color television system developed in West Germany and used by many other countries in Europe. This system is called the PAL system and uses an interlaced 625-line, 25-frames per second picture, except PAL-M (only in Brazil), which uses an interlaced 525-line 30-frames per second picture.

PALplus

An enhancement of PAL that provides 16:9 aspect ratio and improved picture quality (reduced cross-color and cross-luminance artifacts). A PALplus signal is shown in a letterbox format on a normal PAL TV set.

Payload

The actual message, audio data, etc., in a data stream excluding control signals, error checking and other overhead information.

PDU (Protocol Data Unit)

A unit of information (e.g., packet or frame) exchanged between peer layers in a network.

Phase Alteration Line (PAL)
Analog video format standard that features a vertical frequency of 50 Hz, used in most of Western Europe, Australia, and parts of Asia and Latin America.

Pixel
A single point of an image, having a single pixel value.

Pixel Operation
The process of modifying a pixel value for some specific purpose.

Pixellation
In a digital image, a subjective impairment where the pixels are large enough to become individually visible.

Plug-in
A software module that is application-specific and is used in conjunction with another software package.

Point of Presence (POP)
A facility used by a network access provider to house physical equipment that enables subscribers to access the network. The term is used to describe the location where a long-distance service provider connects to a local service provider, and also the location where a service operator houses equipment that enables subscribers to access interactive services.

Post-Production
In video and audio, the process of merging original video and audio from tape or film into a finished program; Post-production includes editing, special effects, dubbing, titling and many other video and audio techniques.

PPV
Pay-per-View; The concept of programming services that are paid for individually.

Predictive Coding
The coding of each pixel by quantizing the difference between its current value and predicted value, computed from past values.

Product
A container for a title

Production
In video, refers to the process of creating programs. In more specific usage, production is the process of getting original video onto tape or film, ready for post-production.

Promotional Package
Package with a short-term availability. Consumer pays a one-time fee to have access to the content for the availability period.

Protocol
Set of syntax rules defining exchange of data including items such as timing, format, sequencing, error checking, etc.

Q

QoS (Quality of Service)

The idea that transmission rates, error rates, and other characteristics can be measured, improved, and, to some extent, guaranteed in advance. QoS is of particular concern for the continuous transmission of high-bandwidth video and multimedia information. Transmitting this kind of content dependably is difficult in public networks using ordinary "best effort" protocols.

Quantization Levels

The predetermined levels at which an analog signal can be sampled as determined by the resolution of the analog-to-digital converter (in bits per sample) or the number of bits stored for the sampled signal.

Quantizing

The process of converting the voltage level of a signal into digital data after the signal has been sampled.

R

RAID (Redundant Array of Independent Disks)

RAIDs can be hardware or software. The nCUBE video server uses a software RAID (level 4) in which content is striped across disks on independent SCSI buses so any individual disk failure does not affect the streaming of video. By placing data on multiple disks, I/O operations can overlap in a balanced way, improving access performance. Since multiple disks increases the mean time between failure (MTBF), storing data redundantly increases fault-tolerance.

Random-Access

In digital memory or mass storage, the ability to access any point or address without any limitation.

Real-Time Feed

A live event, such as a boxing match, where the content is encoded and streamed to the customer on the fly.

Registering or Tagging

Process by which a movie is scanned to create I-Frames to enable trick play. This creates an MPI file. Movies do not play on the nCUBE video server without this file!

Remote Control and Navigation System

Users need a friendly interface to find their way through all the services offered and communicate their requirements to the central Control System.

Repeater

A device that regenerates, re-times, and amplifies electrical signals.

Resolution

Measurement of display image quality in terms of the number of pixels available.

Return Path

In a fully interactive system, there needs to be a signal going from the user to the Control System carrying the user's requests.

Revenue Share
A percentage of the actual price charged to the subscriber (exclusive of taxes) due to the licensor.

Router
A device that sends messages by the best route, especially over large networks.

RSVP
A host protocol used to request a specific quality of service (QoS) from the network to support an application data stream. RSVP generally enables the reservation of resources along a data path, with built-in interoperability for current and future unicast and multicast routing protocols.

RTSP
Real Time Streaming Protocol. A communication protocol between a client and a video server.

S

S-Video
A type of video signal used in the Hi-8 and S-VHS videotape formats. S-video transmits luminance and color portions separately, using multiple wires. In so doing, S-video avoids the NTSC encoding process and the inevitable loss of picture quality that results from it.

Sample
A representative value of a signal at a chosen instant, derived from a portion of that signal.

Sampling
The process of finding the instantaneous voltage of signal at a specific moment or repetitively at a given rate (the sampling rate).

Satellite
A wireless, one-way broadcast medium providing no possibility of a Return Path (other than telephone).

Scalability
The capacity for a computer application or product (hardware or software) to continue to function well as it (or its context) is rescaled (typically, to a larger size). The nCUBE video server architecture allows for you to increase the number of hubs on your system, thus increasing the number of output streams as needed.

Scalable Video
Refers to video compression that can handle a range of bandwidths, scaling smoothly over them.

SDH
Synchronous Digital Hierarchy; a set of telephone standards that enable synchronous multiplexing of data streams on high-speed links.

Server-based video
Refers to video that is streamed from a video server software package.

Set-top Box (STB)

A device that converts digitally compressed video input signals; an addressable communications box is needed to decode the signals as they arrive at the television; depending on the system used it also may need to perform functions such as the decompression of the digital signal, or the handling of the Return Path.

SNMP (Simple Network Management Protocol)

An Internet standard protocol, designed for the management of nodes residing on an IP network.

SONET

Synchronous Optical Network; a set of American standards equivalent to SDH. SONET provides standards for a number of line rates up to the maximum line rate of 9.953 gigabits per second (Gbps). Actual line rates approaching 20 gigabits per second are possible. SONET is considered to be the foundation for the physical layer of the broadband ISDN (BISDN).

Spatial Resolution

The number of pixels horizontally and vertically in a digital image.

STM (Synchronous Transfer Mode/Synchronous Transport Module)

In ATM, a method of communications that transmits data streams synchronized to a common clock signal (reference clock).

Storage Hierarchy & Control System

Even compressed videos require enormous amounts of storage space; the control system must be able to service all the requests coming in.

Streaming

The real-time transfer of data. The file is downloaded in pieces and is viewed as it is downloaded, thus producing a "stream" of data.

Streaming Media

Multimedia content - such as video, audio, text, or animation - that is displayed by a client as it is received from a broadcast network.

Subscription Package

Package with an availability period of one month or longer. For example, a children's package that is available from month to month. Consumer pays a monthly fee for access to the content of the package for the month.

SVGA (super video graphics array standard)

This system can support a palette of up to 16,000,000 colors, although the amount of video memory in a particular computer might limit the actual number of displayed colors to something less than that. Image-resolution specifications vary. In general, the larger the diagonal screen measure of an SVGA monitor, the more pixels it can display horizontally and vertically. Small SVGA monitors (14-inch diagonal) usually display 800 pixels horizontally by 600 pixels vertically. The largest monitors (20 inches or more diagonal measure) can display 1280 x 1024, or even 1600 x 1200, pixels.

Synchronous

Data communication that requires that each end of an exchange of communication respond in turn without initiating a new communication. A typical activity that

might use a synchronous protocol would be a transmission of files from one point to another. As each transmission is received, a response is returned indicating success or the need to re-send. Each successive transmission of data requires a response to the previous transmission before a new one can be initiated.

T

T-carrier system

The first successful system that supported digitized voice transmission. The original transmission rate (1.544 Mbps) in the T-1 line is in common use today in Internet service provider (ISP) connections to the Internet as well as corporations. Another level, the T-3 line, providing 44.736 Mbps, is also commonly used.

TCP/IP

Transmission Control Protocol/Internet Protocol; The Internet's most common transmission protocol, and can broadly be described as the first-language of the Internet. IP (Internet Protocol) is simply the method for forming and then routing "packets" of data; TCP (Transmission Control Protocol) adds three critical functions:

- **Packet Sequencing**: TCP gives each "packet" of data a number, so that all packets are properly reassembled at the receiver.
- **Reliability**: TCP ensures that all "packets" of data sent off actually arrive by requesting retransmission of the packets if they get lost.
- **Flow Control**: When the Internet becomes clogged, all travelling data is expected to retreat somewhat to allow fair use of the available space. TCP allows the data to do this.

Telco

Slang for telephone company, the provider of telephone services. Often the local supplier rather than the long-distance supplier.

Temporal Resolution

The ability of the display to reproduce adequate detail to allow the visual system to distinguish the separate parts or components of an object that is moving through the display.

Terabyte

A measure of memory capacity that is two to the 40th power or "roughly" (as a decimal number) a thousand billion bytes (that is, a thousand gigabytes).

Time Code

A system of identifying frames recorded on videotape by assigning each frame a chronological number based on a 24-hour clock.

Token Ring Network

A token ring network is a type of local area network. In a token ring network, all workstations are connected in a ring or star topology and a token-passing scheme is used to prevent the collision between two workstations who want to send messages at the same time.

Transit
Operating system on the nCUBE video server.

Transmission System
High speed links are required to deliver the vast amounts of information in a timely manner.

Tributary
One of several data streams being multiplexed into an aggregate data stream.

Trick Play
The ability to do VCR remote-like functions including fast forward, rewind and pause. VOD systems usually allow trick play, NVOD systems do not. I-Frames in VOD allow this capability.

Trunk
The communications line between two points or switching systems; mostly the connection between two major switching centers.

Twisted Pair
The most common existing wired system as it is present in millions of telephone lines going to houses, but also the most limited in its bandwidth.

U

UDP
User Datagram Protocol; A communications transport protocol layer that is an alternative to the Transmission Control Protocol (TCP) layer. Like TCP, it interfaces with the Internet Protocol (IP) layer. UDP, however, does not provide the data gathering reliability of TCP. For example, it does not provide sequencing of the packets in which the data arrives. This means that the application program must be able to provide these services.

Universal Network
The idea of a single network that integrates the existing voice and public telecommunications network (including the Internet), cable TV, data networks, and video broadcast networks so that they work together well.

V

VBR (Variable Bit Rate)
A form of data delivery where bits are grouped irregularly and vary with time. Compression that can be delivered at a variable bit rate can adapt to changing network bandwidths as well as to changing properties of a video, such as the amount of motion.

Video on Demand
Video that can be requested at any time and is available at the discretion of the end user.

W

Wire

A logical connection between a physical connector of a board to a group of clients (a service area). The wire can be used to model bandwidth limitations and possible connections, while a node, board, and connector model physically available hardware.

Preface

This document describes the nCUBE VOD for TV Guide Interactive solution, which provides both transaction VOD (TVOD) and subscription VOD (SVOD). The nCUBE VOD solution enables fully interactive VOD services for Motorola DCT set-top boxes running the TV Guide Interactive Electronic Programming Guide (EPG).

With the nCUBE VOD Solution for TV Guide, service operators can quickly implement true interactive VOD on the Motorola HFC plant with no interruption to existing services.

This solution seamlessly integrates into any Motorola broadband network architecture. nCUBE has tested and integrated this solution to ensure that deployment timelines are rapid, startup costs are minimal, and service launch success is ensured.

What's in this Guide

This document includes the following sections:

Section	Contents
Chapter 1: System Architecture	Overview of the nCUBE VOD for TV Guide solution: • System components • Architectural overview
Chapter 2: Network Communication	Interactive network communications topics: • In-band and out-of-band communications • System initialization and set-top box auto-discovery • Carousel structure, creation, and updating • Data storage formats • Transport heartbeat
Chapter 3: VOD Products	Discussion of the TVOD, SVOD, and FOD options and details of operation.

Section	Contents
Chapter 4: Purchasing and Billing	Discussion of the options for purchasing assets and the billing procedures for each: • TVOD asset purchasing, provisioning, billing, and deleting from the system • SVOD subscription purchasing, provisioning, billing, and deleting from the system
Chapter 5: System Event Communication Flow	Descriptions of VOD system communications: • ODA Metadata Update • ODA Client Update • Initiating a VOD Session • User Navigation • Posting a TVOD Billing Event • Session Setup - New TVOD Purchase • Up-sell to SVOD • Session Setup - First Viewing of SVOD Asset • Session Setup - Resume Playing an Asset • Stream Control Operation • Transport Heartbeat • Session Teardown • Deleting a TVOD Asset
Glossary	Terminology and definitions

Chapter 1: System Architecture

This section includes:

- Solution component list
- Architectural overview

Solution Components

Table 1-1 and Table 1-2 define the system components and version numbers that comprise the nCUBE VOD for TV Guide Interactive solution.

Table 1-1: Matrix of Motorola DCTs With TV Guide Components

Component	Hardware	Software
DCT-1700 STB	Phase 0-1	TV Guide Version: 17.44 (A17)
DCT-1800 STB	Phase 0	TV Guide Version: 17.44 (A17)
DCT-2000 STB	Phase 0-9, including option K and L set-tops*	TV Guide Version: 17.44 (A17)
DCT-2500 STB	Phase 0	TV Guide Version: 60.0x
DCP-501 STB	Phase 0	TV Guide Version: 17.44 (A17)
DCT-5100 STB	n/a	TV Guide Version: 51.22
DCT-6200/6208 STB	n/a	TV Guide Version: 51.22
DCT Firmware	Versions 7.65, 7.72, 7.77, and 7.85, or the equivalent (7.85 required for TSID support)	

* When properly formed metadata is received by the ODA server, option K or L functionality (SPDIFF) can be enabled via the TV Guide API.

Table 1-2: nCUBE Component Matrix

Component	Software	Notes
Content	transport stream typically 3.75 Mbps audio: 2 Channel AC3 or Dolby 5.1 digital surround	
ODA Client	ODA Client for TV Guide Version 2.x	compatible with ODA 2.3 and nABLE 1.7.4
ODA Server	nCUBE ODA Server 2.3	runs on Solaris 2.8
VOD System Manager	nCUBE nABLE 1.7.4	runs on Solaris 2.8
Video Server	nCUBE n4, n4x, n4xR2	
Video Server Operating System	nCUBE Transit 3.6	
Video Server Pump	nCUBE nVS 3.6	

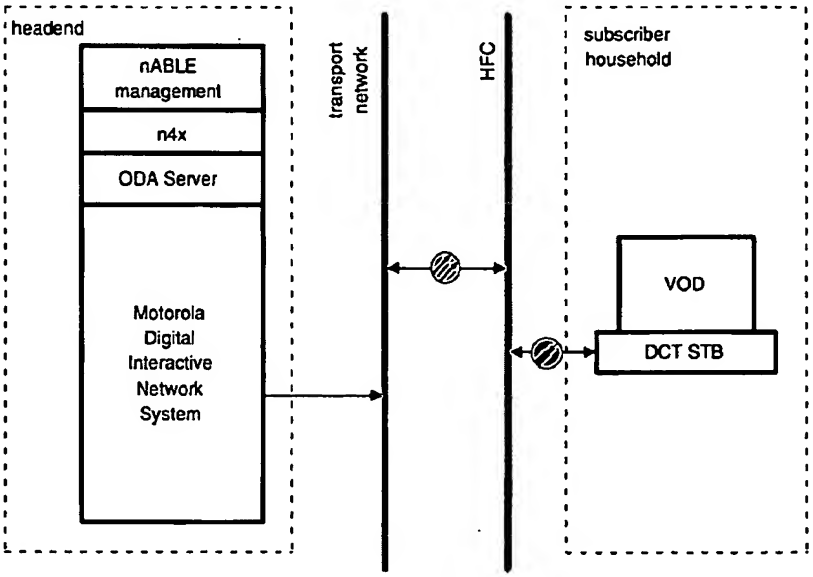
VOD Architectural Overvi w

The essential components of the nCUBE VOD for TV Guide solution are:

- nCUBE n4, n4x or n4xR2 Streaming Media System
- nABLE VOD System Management Application Suite
- Motorola Digital Interactive Network System
- Motorola DCT set-top boxes equipped with the TV Guide Interactive application

These system components are logically illustrated in Figure 1-1, and each system component is described in detail below.

Figure 1-1: VOD for TV Guide System Architecture

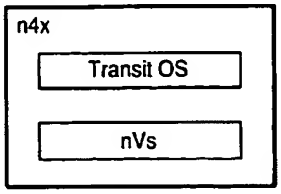


nCUBE Streaming Media System

The nCUBE Streaming Media System is the video server system responsible for streaming content out to the Motorola digital network. The streaming media system includes:

- n4, n4x or n4xR2 on-demand server
- Transit video server operating system
- nCUBE Video Server (nVS) software

Figure 1-2: Video Server System Components



n4x On-Demand Server

The n4, n4x or n4xR2 video server stores the VOD content library, handles streaming media requests, and outputs video streams for transport over the digital system. Supported output formats include:

- QAM Intermediate Frequency (IF) format to RF upconversion equipment
- Ethernet output to third-party RF modulation equipment

The On-Demand Server is a highly-optimized video server with the unique ability to service thousands of simultaneous stream requests using a single copy of the content file.

The n4, n4x and n4xR2 servers are fourth-generation video server platforms running the most robust advanced streaming media applications available.

Transit video server operating system

Transit, the operating system for the n4, n4x and n4xR2, incorporates a high-performance kernel designed specifically to support streaming media applications, such as the nCUBE Video Server (nVS).

nCUBE Video Server (nVS)

nVS is a scalable video software engine that stores video and delivers broadcast-quality, interactive services to the home and desktop. nVS resides on the n4, n4x and n4xR2 video servers, running on top of the Transit OS.

nABLE VOD System Management Application Suite

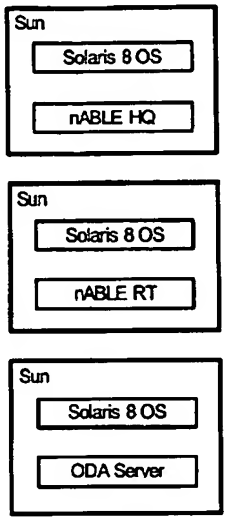
The nABLE Application Suite includes a number of modular applications that together comprise a complete VOD system management application suite. The nABLE applications include open APIs for interdependency with other headend applications and network equipment.

The TV Guide Solution architecture uses these nABLE applications:

- nABLE Headquarters (HQ)
- nABLE Realtime (RT)

Depending on deployment, each nABLE application can be hosted on its own Sun Microsystems server running the Solaris OS. Alternatively, both applications can share the same server. The size of each host is appropriate to the size of the deployed system.

Figure 1-3: nCUBE nABLE and ODA components



For additional deployment options, the solution can support multiple VOD systems on a single headend.

nABLE HQ

The nABLE HQ server application is the central VOD system manager. As such, a single nABLE HQ manages one or more ODAs, as well as one or more video servers and associated nABLE RTs. nABLE HQ stores information about content as *metadata* and sends the metadata to the ODA server(s). nABLE HQ is hosted on a Solaris server.

nABLE HQ is also responsible for system configuration, file management, metadata management and systems operations monitoring. nABLE HQ provides an operator interface via HTML pages that can be viewed with a web browser.

Specific nABLE HQ functional capabilities include:

- Serving the system management graphical user interface (GUI)
- Providing detailed historical data for all VOD sessions
- Administering system users, passwords, and permissions
- Storing the system configuration and network topology
- Managing content distribution and registration for each video server
- Defining product metadata and purchasable event information
- Reporting session setup and stream usage statistics
- Providing a Quality Assurance System for product metadata management
- Storing and serving product metadata to the ODA set-top box application
- Providing HTML-based documentation and context-sensitive Help

nABLE RT

nABLE RT performs intelligent network resource allocation and load balancing. nABLE RT maintains a complete inventory of the streaming media network resources available and assigns network resources for each streaming session. nABLE RT updates the network configuration map in real time, performing load balancing and bandwidth allocation for the streaming media system. In effect, nABLE RT is the traffic manager handling all the streaming session requests coming into the system, and in turn managing the network resources that stream video.

nABLE RT is hosted on a Solaris server. Depending on the network topology and size, operators can deploy multiple nABLE RTs, each associated with a distinct video server. One or more nABLE RTs can be associated with a single nABLE HQ.

nCUBE On-Demand Application (ODA)

nCUBE ODA Server

The ODA server communicates information about available content offerings from nABLE HQ to the ODA client application on the set-top box. The ODA server also communicates billing posts to the nABLE Billing and Provisioning Service (BPS).

Motorola Digital Interactive Network System

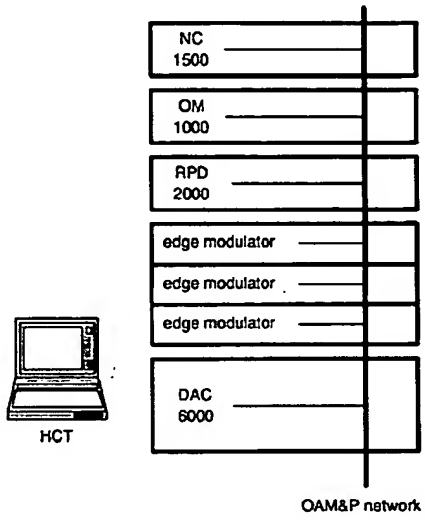
The Motorola network comprises a complete headend-to-subscriber digital system. The network has a realtime return path enabling interactive television services, including Video on Demand.

The Motorola Network for the TV Guide solution includes the Operations, Administration, Maintenance, and Provisioning (OAM&P) network and the following integral system components:

- DAC 6000
- NC 1500
- OM 1000
- RPD 2000
- edge modulator
- HCT

These components are logically illustrated in Figure 1-4.

Figure 1-4: Motorola Interactive Network Components



DAC 6000

The DAC 6000 is the headend management center, providing definition for all the Motorola system components in the headend. In a VOD system, the DAC 6000 core functionality includes:

- Configuring terminal communications and client application code downloads
- Scheduling services and programs
- Defining channel map assignments
- Configuring headend components
- Supporting interactive network functions
- Interfacing to network management devices

NC 1500

The Motorola NC 1500 Network Controller is used in digital cable networks to support real-time network interactivity for DCT set-top boxes. The NC 1500 acts as a gateway between two different types of networks: The IP network connecting application servers and the digital cable network connecting the set-top boxes.

The NC 1500 supports:

- Aloha Media Access Control (MAC) protocol to allow real-time upstream/downstream transmission between application servers and digital terminals
- A proxy function between User Datagram Protocol/Internet Protocol (UDP/IP) and Simple Connectionless Protocol (SCP) so non-IP addressed terminals (DCT set-top boxes) can support UDP to application servers
- Simple Network Management Protocol (SNMP) for configuration and status monitoring.

OM 1000 The OM 1000 provides the out-of-band (OOB) data path to the DCT set-top box. The OM 1000 also multiplexes MPEG-2 streams for downstream delivery.

RPD 2000 The RPD 2000 (Return Path Demodulator) is the upstream communications device for communications with the DCT set-top boxes.

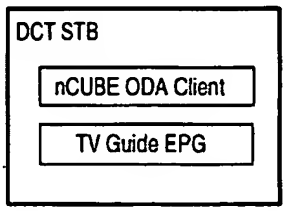
Edge Modulator The Edge Modulator provides video delivery, converting MPEG streams encapsulated in IP and carried over Gigabit Ethernet from the video server to QAM RF format for transport over the cable HFC plant.

HCT The Headend Configuration Tool is a portable device (laptop PC) that interfaces with the other headend components. The HCT provides the tools necessary to configure network devices such as the NC 1500 and the OM 1000.

Motorola DCT Set-top Boxes

The Digital Addressable Interactive Digital Consumer Terminal (DCT) is the set-top box in this solution. The DCT set-top box is the host for the TV Guide Interactive Electronic Program Guide (EPG) and the nCUBE ODA client application. See Table 1-2 on page 10 for the list of supported DCT models.

Figure 1-5: DCT Set-top Box Components

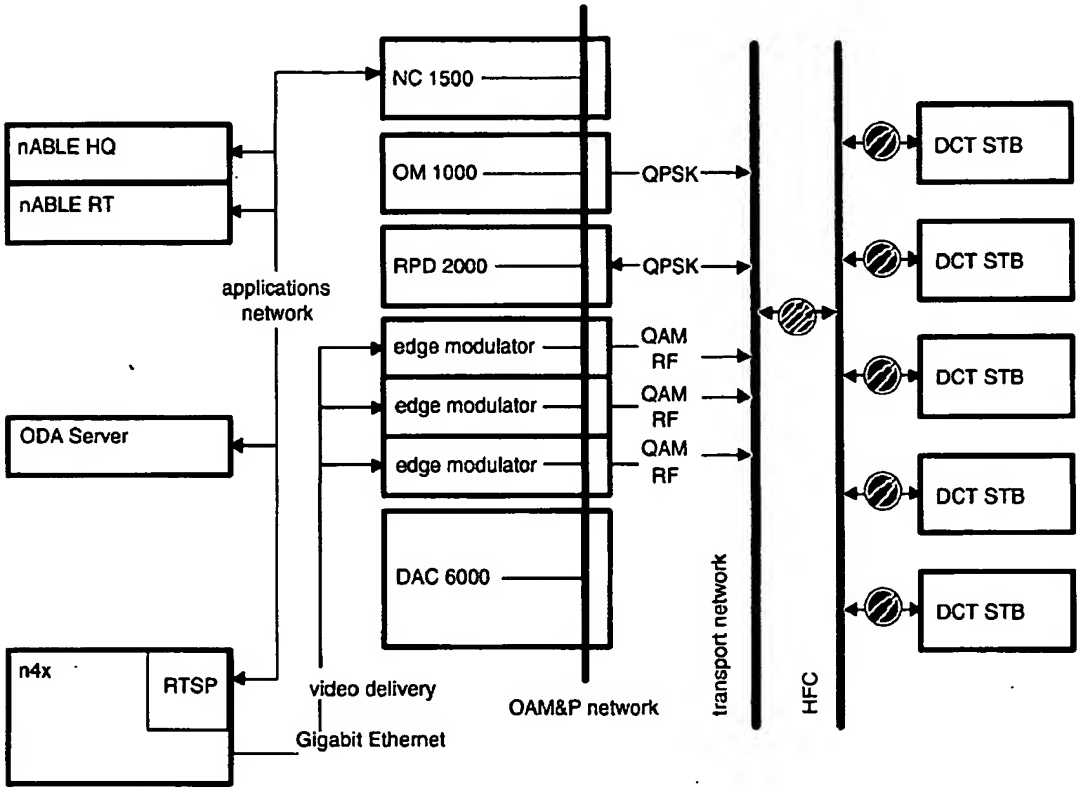


Network Architecture

Figure 1-6 illustrates the logical network architecture at the major system component level.

For detailed system communication between system components, see *Chapter 5: System Event Communication Flow.*

Figure 1-6: Logical Network Architecture of Major System Components



Chapter 2: Network Communications

This chapter describes:

- Interactive Network Communications
- ODA 2.3 In-Band Communications
- ODA 2.3 Out-of-Band Communications
- Initialization Carousel
- Transport Heartbeat

For detailed descriptions of the VOD messages passed over the interactive network, see *Chapter 5: System Event Communication Flow* on page 55.

Interactive Network Communications

The video server system and the cable network use two different network protocols. So from a network communications standpoint, the defining characteristic of the interactive television system is the internetworking between an RF-based digital cable network and an IP-based Ethernet network. Consequently, all data communications between these two networks must be modulated or demodulated to a data format acceptable to the recipient device or program.

Motorola Interactive Network

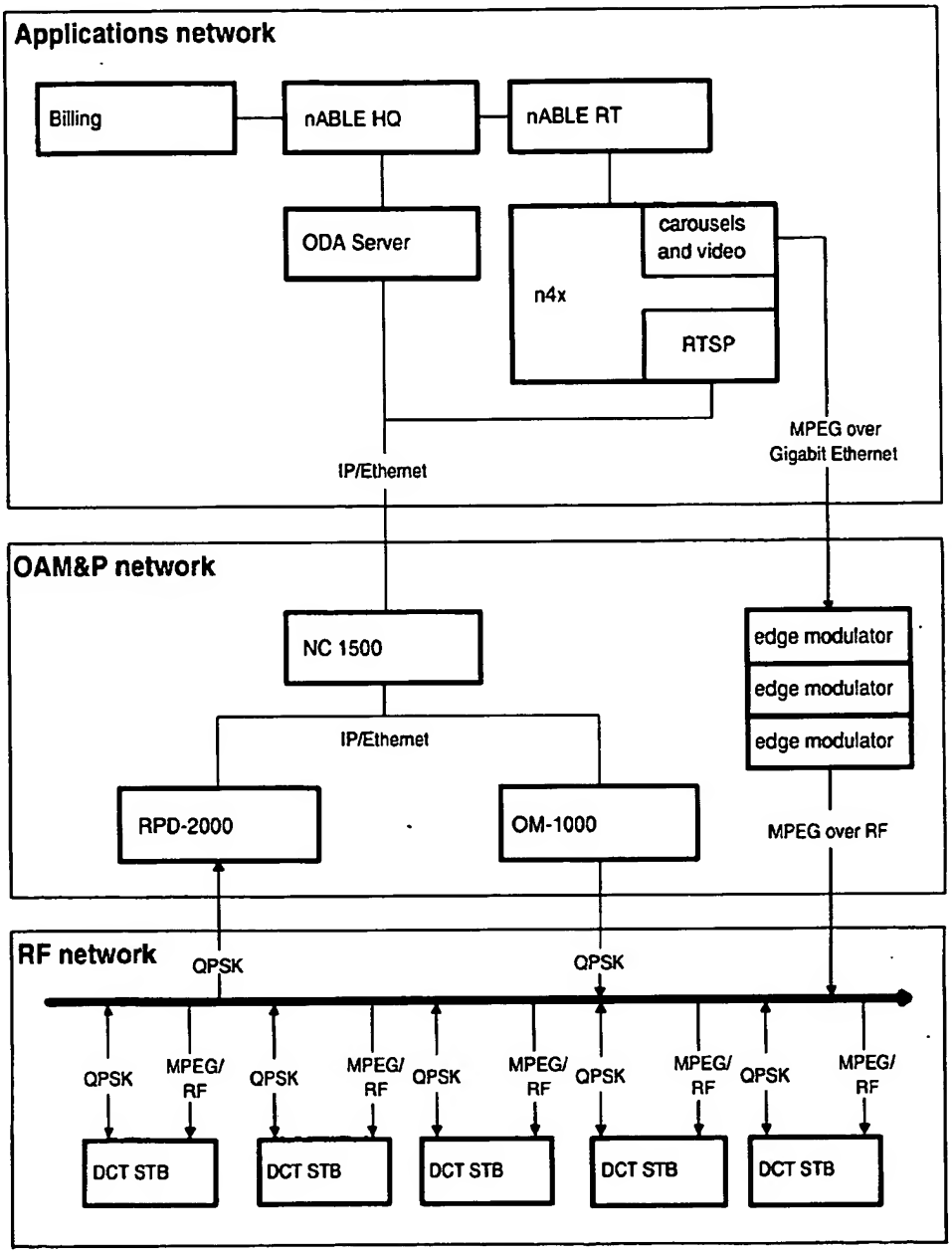
The Motorola Interactive Network fully supports interactive communications between DCT set-top boxes and the interactive VOD network. Specifically, the Motorola Network Controller 1500 (NC 1500) acts as the gateway between the RF and the IP network. The NC 1500 employs a proxy function between User Data Protocol/Internet Protocol (UDP/IP) and Simple Connectionless Protocol (SCP) that enables non-IP equipped DCT terminals to communicate with interactive application servers.

The two-way, interactive communications-enabling components in the Motorola network are:

- The Return Path Demodulator (RPD 2000), which receives, demodulates, and processes upstream communications data from the network of set-top boxes and forwards the data to the NC 1500
- The Out-of-Band Modulator (OM 1000), which receives UDP data from the NC 1500 and modulates the data onto an RF signal for delivery to the set-top boxes downstream

Figure 2-1 shows an overview of network communications. (The DAC 6000, shown in Figure 1-6 on page 17, has been omitted because its subscriber management functions are not part of the video delivery functions under discussion in this chapter.)

Figure 2-1: Network Communications: Logical View



In-band and Out-of-band Communication

Data and metadata exchanges between the VOD server system and ODA clients can be sent in-band (IB) or out-of-band (OOB). The in-band path is a high-bandwidth stream of approximately 38 Mbps that delivers video in one direction only: from the server to the set-top. Other in-band communications include:

- MPEG movie data
- forward-path movie metadata
- graphic images
- nearly all client control and client configuration data, including service group, ODA server, and video server addressing information

The out-of-band path is bidirectional, but has a much narrower bandwidth (a total of 1.5 Mbps, not all available) than the in-band path. Because it provides a back-channel, the out-of-band path is best suited for subscriber-unique, dynamic requests, such as:

- purchase requests
- navigation events
- stream control operations

Scaling a VOD system to accommodate thousands of users quickly results in congestion on the out-of-band channel. The remedy is to take advantage of the much greater capacity of the IB resources. The goals of ODA 2.3 are

- to minimize VOD navigator transactions in general
- to eliminate all static movie metadata on the out-of-band channel, which represents more than 90% of all ODA data transactions

The methods nCUBE implements to handle interactive network communications in the IB and OOB spectrums are described below.

ODA 2.3 In-band Communications

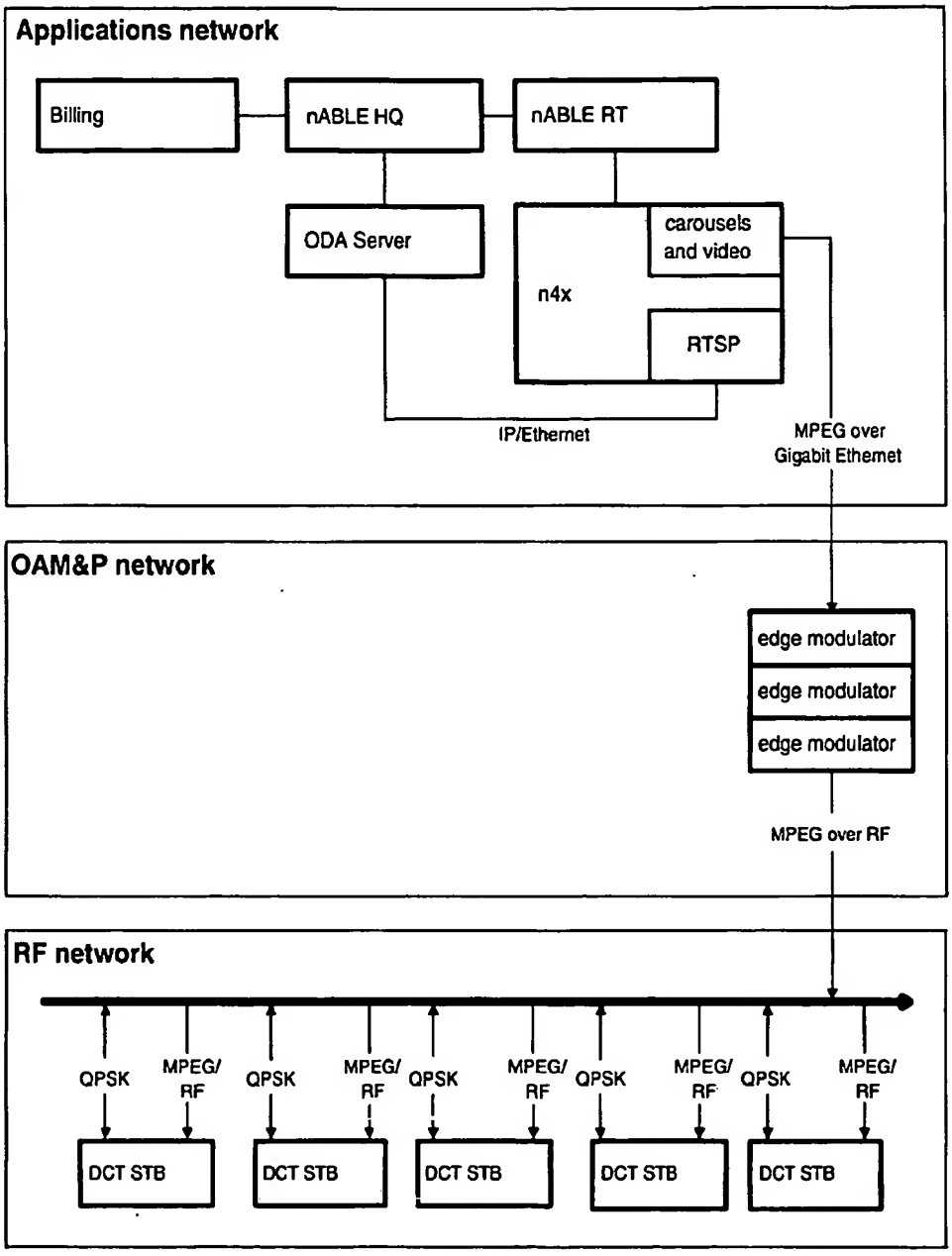
In the ODA 2.3 architecture, in-band communication is used to deliver movie metadata (DC2TEXT) and certain initialization data (such as service group ID) via QAM 64 or QAM 256 multi-program transport streams (MPTS).

In-band communications include:

- **Video stream transport**, including movies and trailers streamed from the nCUBE video server to the edge modulators. The modulator converts the IP/Gigabit Ethernet stream to a QAM RF stream on a particular frequency, where it is then delivered in-band to the HFC network and the set-top box.
- **Static movie metadata** such as movie description and pricing information. Static movie metadata is encapsulated in DC2TEXT, wrapped in MPEG-2 transport, carouseled on the nCUBE video server, and streamed via the upconverter.
- **Initialization data** that allows the set-top box to "auto-discover" its service group and other control data. Initialization data is also encapsulated in DC2TEXT, carouseled, and streamed over the in-band via the upconverter.
- A **trigger** mechanism that enables the ODA server to signal the ODA client when a carousel's content has been updated.
- A **dynamic cover stream** mechanism for tuning the DCT set-top box.

Figure 2-2 illustrates the in-band communications path.

Figure 2-2: In-band Communications: Logical View



Carousels

nCUBE has engineered a *carousel* method to send data to the set-top boxes. A carousel is a data stream containing a small amount of relatively static data that is transmitted in-band. Within the carousel, the data is repeated numerous times. The carousel itself loops repeatedly. The effect is that the data contained in the carousel is constantly available to the ODA client application that resides on the set-top box. The in-band carousel is an effective mechanism for delivering downstream data and metadata, shielding the limited OOB spectrum from the vast majority of frequent client requests.

A carousel is created by the ODA server (in most cases), copied to the nCUBE video server, and then streamed by the video server. The ODA server refreshes the content as needed. A "trigger" convention, described in *Metadata Update Triggers* on page 31, allows the ODA server to signal the ODA client when a carousel's content has been updated.

nODA 2.3 employs three types of carousels to make data accessible to the ODA client:

- Initialization carousels containing STB-specific control data used at startup
- Configuration carousels containing everything needed to set up the top-level VOD screens, a combination of movie metadata such as indexes of categories and packages, along with some graphics and configuration parameters
- Genre carousels containing asset-specific metadata for all the assets in one category, such as the description and rental details for every action movie

Because they both contain metadata, the genre and configuration carousels are often referred to collectively as *metadata carousels*.

Two other types of carousels, cover streams and triggers, assist with the operation of the system.

Initialization Carousel

The purpose of the initialization carousel is to provide the client with startup information at the beginning of a VOD session. The initialization carousel is a control data carousel that contains:

- the client's service group ID
- a pair of VCNs for the home channel and its backup channel
- VCN for the home channel for barkers
- a configurable error string for failed purchases (might contain the local support phone number, for example)
- a translation table, mapping up to 100 destination strings (Mux IDs and program numbers) to 100 VCNs
- the ODA server IP address
- the ODA server port number
- a list of IP addresses for up to four RTSP servers, which are always assumed to be on port 554

- the upstream Heartbeat interval in milliseconds, specifying how often the ODA client signals the video server
- the downstream Heartbeat interval in milliseconds, specifying how often the ODA client should expect to find heartbeats embedded in the video stream

The client uses the heartbeat timers in milliseconds. For example, an upstream heartbeat setting of 30,000 means the upstream heartbeat timeout is 30 seconds.

The client accesses the initialization carousel and extracts the VCNs for the home channel and its corresponding backup channel. VCNs A and B are pointers to the primary and secondary MMC/trigger locations, respectively. With this information, the set-top box can retrieve movie metadata.

Structure of Initialization Carousel

Figure 2-3 illustrates the structure of an initialization carousel.

Figure 2-3: Structure of an Initialization Carousel

VCN A = VCN for primary MMC
VCN B = VCN for secondary MMC

The Service Group ID identifies the ODA client's service group. The VCNs are used to index movie metadata and triggers within a QAM.

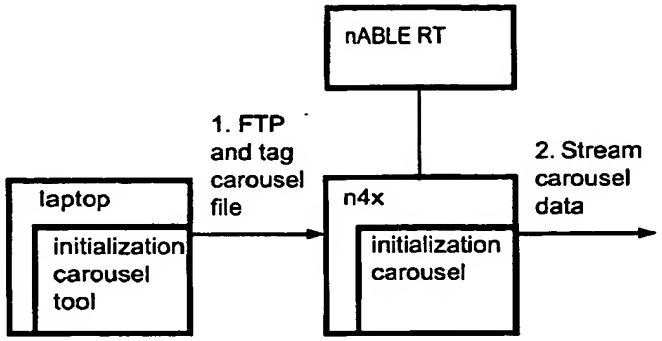
Creating Service Groups

The operator configures service groups through the nABLE interface. This step must happen before the initialization carousel is created.

Creating and Managing Initialization Carousels

The ODA server does not create the initialization carousel. nCUBE supplies a Java-based initialization carousel tool for that purpose. Operators can input the initialization parameters from an XML file or through the tool's GUI. From this control data, the initialization carousel tool creates an MPEG-2 file, which is placed on the nCUBE video server in the directory that serves the in-band carousel. The video server tags the carousel file for streaming and begins streaming as instructed by nABLE RT. This process is illustrated in Figure 2-4.

Figure 2-4: Initialization Carousel Creation



Metadata Carousels

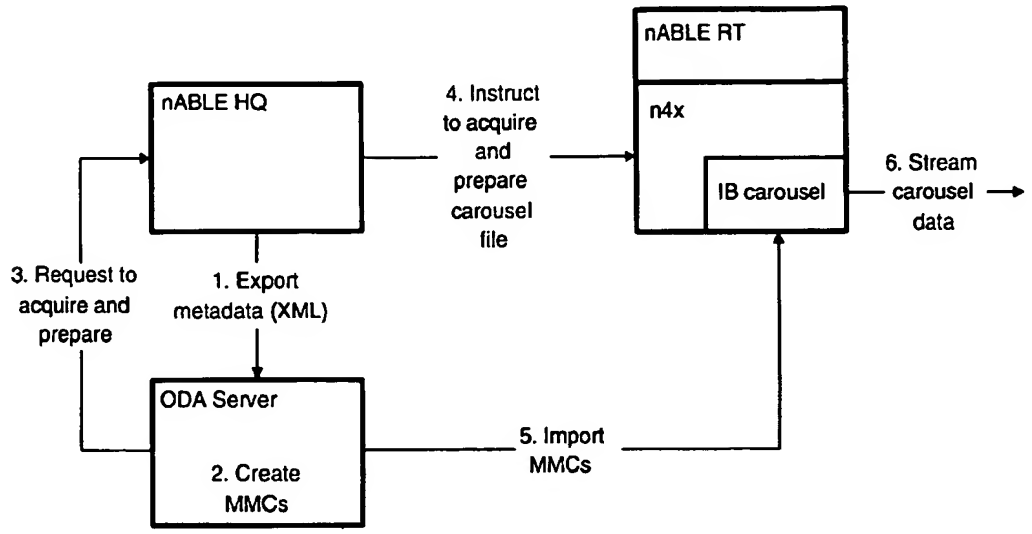
In the ODA 2.3 architecture the nABLE HQ application manages metadata carousels through its carousel management API.

Creating and Managing Metadata Carousels

When content comes into the system from the content provider, the MPEG file is accompanied by an XML file containing product and category data. The incoming files automatically start this sequence of events:

1. nABLE parses the various XML files as metadata.
2. If they wish, MSOs can add or change the metadata through the nABLE GUI.
3. nABLE combines the metadata for a batch of content files and creates a movie metadata file in a standard XML format. TVOD and SVOD metadata are combined in the XML file.
4. nABLE HQ exports the movie metadata to the ODA server.
5. The ODA server converts the movie metadata to DC2TEXT format and inserts it into MPEG-2 files. The conversion generates a configuration carousel, a set of genre carousels, and enough *movie metadata containers* (MMCs) to hold the carousels.
6. The ODA server uses nABLE's Carousel Management Service to send the MMCs to the nCUBE video server, tag (prepare) them, and start them streaming. This process is illustrated in Figure 2-5.

Figure 2-5: Movie Metadata Carousel Creation



Updating Metadata Carousels

An update to the movie metadata consists of replacing the MPEG files streaming on the in-band carousels. In the nCUBE architecture, updates to the metadata collection are input through the nABLE HQ interface and published to the ODA server, which then prepares the MPEG-2 file and requests acquisition from nABLE as described above.

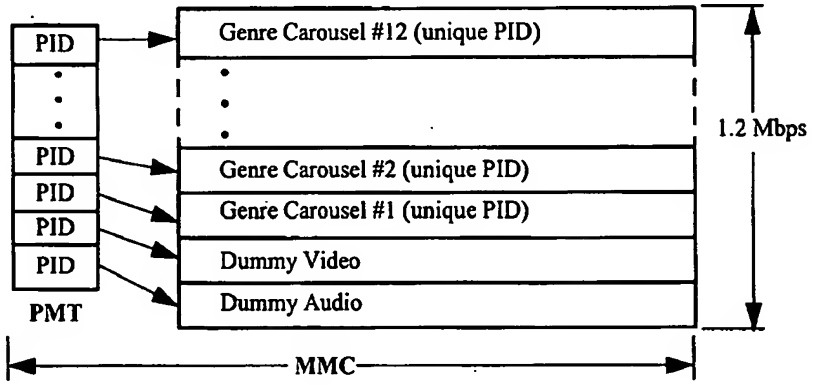
Movie Metadata Containers

An in-band MMC provides transport for a collection of carousels. It runs as a continuous, looping MPEG stream on a predetermined virtual channel number (VCN). The MMC is an MPEG-2 single program transport stream (SPTS). The bitrate of this stream is 1.2 Mbps, chosen for optimum interoperability with the DCT 2000.

MMC Structure

Within the MMC are elementary streams, mapped according to the ATSC PID mapping standard, which comprise the service. Up to 12 elementary streams transport individual carousels, each with its own data packet ID (PID). Figure 2-6 shows the structure of a typical MMC.

Figure 2-6: Typical Movie Metadata Container



Two of the PIDs are dedicated to packets that facilitate the set-top box tuning mechanism but carry no payload: one dummy audio PID and one dummy video PID.

Genre Carousels

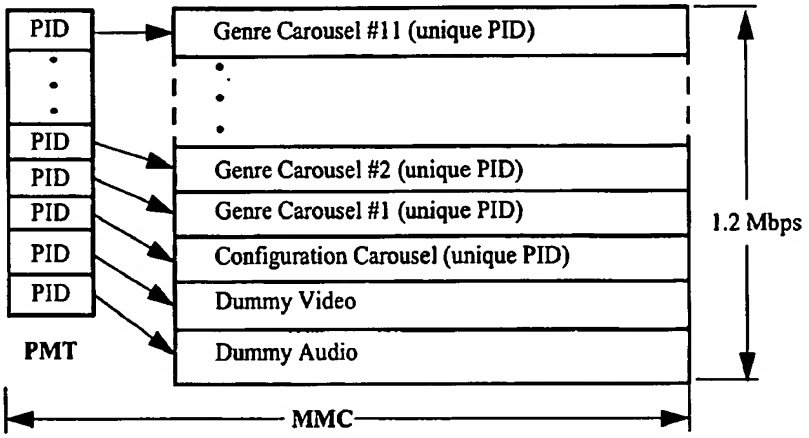
Each of the remaining PIDs in the MMC corresponds to a group of packets containing data for one category, known as a *genre carousel*. Ordinary MMCs can accommodate a maximum of 12 genre carousels; multiple MMCs are used to provide for more categories and assets. The solution has been tested with as many as 150 categories and 100 assets per category.

Extracting Metadata

The ODA client on the set-top box tunes each VCN and extracts payload packets from its corresponding MMC, which contains movie metadata for the TV Guide EPG to present to the subscriber. MMCs with unique PIDs can be transferred as-is to the client or can be remapped via the ATSC PID-mapping paradigm.

The first MMC in a sequence carries a configuration carousel. Consequently, the first MMC can accommodate 11 genre carousels, one less than the typical MMC (Figure 2-7).

Figure 2-7: First Movie Metadata Container (MMC)



Configuration Carousel

The configuration carousel contains the following data:

- the MSO logo displayed on the initial screens of both TVOD and SVOD categories
- advertising graphics and associated text for two panel ads, also displayed on initial screens
- index of categories into which the assets are organized
- index of SVOD packages offered to the subscriber
- VCNs for other MMCs
- configuration information for all genre carousels within all MMCs

Asset Categories

The structure of categories and subcategories displayed on the VOD screens is automatically compiled from the categories assigned to the current assets by their content providers. Every MPEG content file comes from the provider with a matching XML file containing metadata, including the content's category. nABLE parses this metadata and passes it to the ODA server.

If nABLE imports a category that provides an alphabetical list, such as "Movies A-Z," it can be configured to subdivide the category into smaller lists, such as A-C, D-H, and so forth. These subcategories are generated automatically and are usually configured by nCUBE.

If an MSO chooses to create its own categories, the operators can create categories manually through nABLE. nABLE can also be used to change categories. The change has no effect on any current viewing of a program, but shows up the next time the subscriber returns to the categories screen.

Advertising

The MSO can supply advertisements to replace the TV Guide panel ads on the title information screens. An advertisement consists of two files: a graphic file and an associated file of text to be displayed when a subscriber selects the ad graphic. The format for the ad files is defined by the CableLabs metadata specification. The maximum size for an ad graphic file is 4 kilobytes.

The ads can be changed at any time. The graphic and text files are loaded onto the ODA server host in a directory specified in the ODA server's configuration. The new ads show up with the next change in movie metadata, which causes the ODA server to generate a new carousel. The next time the ODA client refreshes its configuration information, the new advertisements appear in the GUI. See *Metadata Update Triggers* on page 31 for more information on how this works.

MSO Logo

At VOD session startup, the TV Guide Application interface is customized with the MSO logo. The MSO logo propagates through the system in the same way as the advertisements. The maximum size for an MSO logo file is 3 kilobytes.

Video Stream Transport

The video content consists of *assets*, such as movies, and *barkers*, which are trailers for coming attractions.

Video Assets

Movies and other video assets are streamed from the nCUBE video server, converted to a QAM stream, and delivered in-band to the set-top box. The nCUBE VOD solution has been tested with 2000 video assets, including up to1000 transaction VOD (TVOD) assets and up to 1000 combined subscription VOD (SVOD) and free on demand (FOD) assets. nABLE file services manage the content inventory. The process of loading, preparing, and distributing content files is fully automated.

Video Barkers

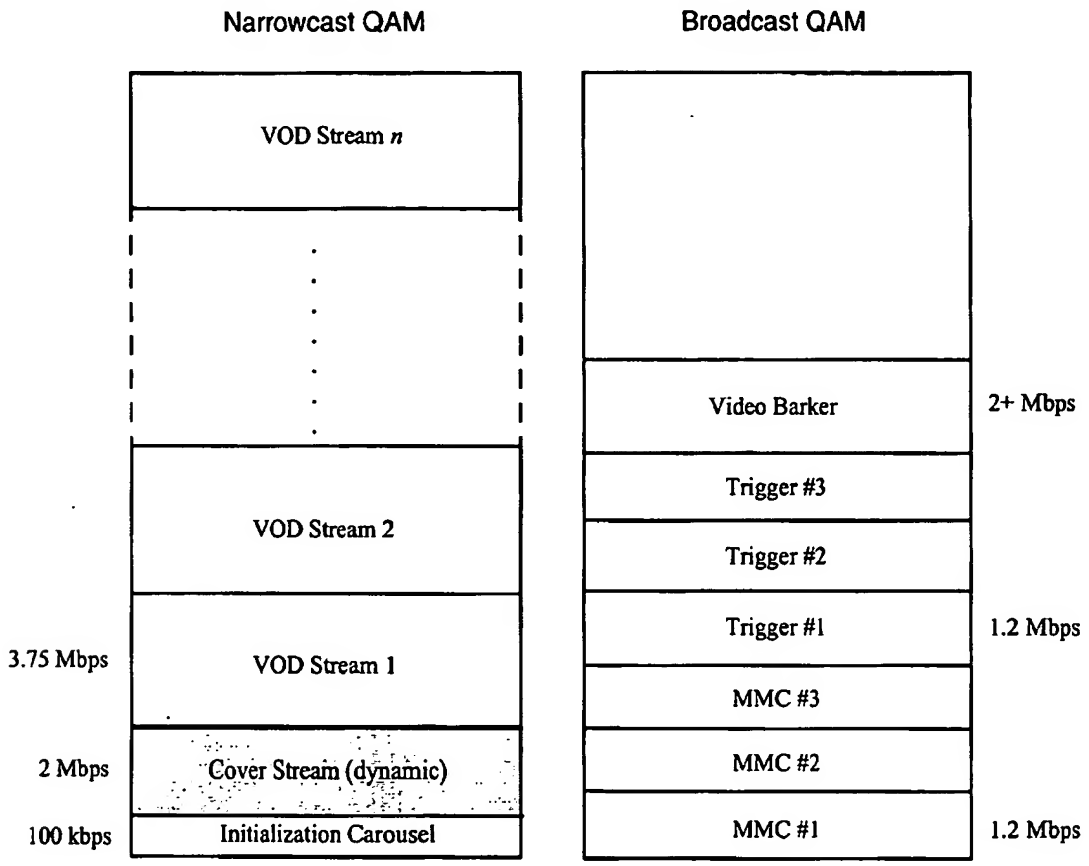
One type of FOD asset is a barker, a collection of preview trailers output by the nCUBE server as a single stream. A barker runs as a carousel, repeating the sequence of trailers in a continuous looping MPEG stream. Barkers are loaded onto the system and distributed like any other video content file.

When the subscriber brings up the TV Guide Application, the previews appear in a box in the upper left-hand corner of the screen. Barkers are displayed on the category and subcategory screens of both TVOD titles and SVOD subscriptions.

QAM Layout

A broadcast QAM contains video barkers, metadata carousels, and triggers. A narrowcast QAM contains video programs, the initialization carousel and, when necessary, a dynamic cover stream. Figure 2-8 shows the structure and contents of typical narrowcast and broadcast QAMs.

Figure 2-8: QAM Structure and Contents

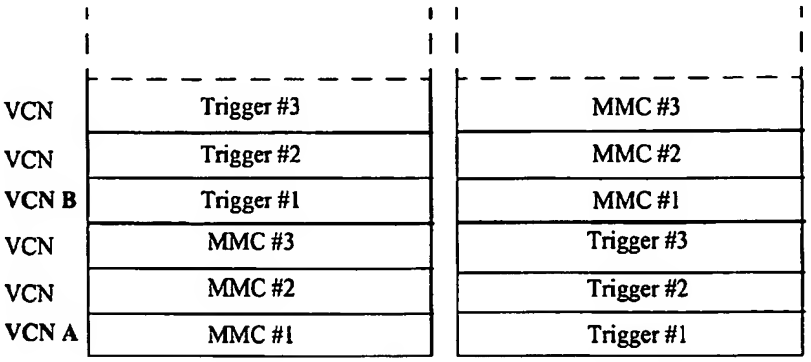


Metadata Update Triggers

MMCs are arranged in pairs. One member of each MMC home channel/backup channel pair contains movie metadata. The other member of the pair contains a placeholder called a *trigger*. Each MMC that contains metadata has a corresponding trigger MMC. The trigger typically occupies 1.2 Mbps of bandwidth and identifies itself as a placeholder.

At any given time, all of the home channels listed in the initialization carousel contain valid metadata while their backup channels contain only triggers, or the opposite is true: the backup channels hold valid metadata while the home channels contain only triggers. Therefore, a broadcast QAM can be in one of two states: valid metadata in the home channels, or valid metadata in the backup channels (Figure 2-9).

Figure 2-9: Two States of a QAM That Carries Movie Metadata



The set-top box tunes to the primary home MMC VCN and extracts the program information. If the set-top box finds a data carousel, then it can cache that metadata and display it.

If the set-top box does not find a data carousel but, instead, finds a data structure known as a trigger, then the set-top box retunes to the secondary backup MMC to find the data carousel.

When, at some point, the client attempts to read the data carousel but, instead, finds a trigger, the client recognizes that the operator has launched a new data stream on the other channel. This causes the client to flush its cache and reload the data carousel from its alternate location.

The operation of MMCs and triggers is entirely VCN oriented; their placement within QAMs is irrelevant. While MMCs and triggers are most commonly limited to a single frequency for convenience, they work equally well when distributed among several QAMs.

Dynamic Cover Streams

Because the tuner on the DCT 2000 set-top box requires a ratio of payload to null data within the QAM, the DCT 2000 firmware cannot tune a low-bitrate DC2TEXT stream unless there is other payload data within the QAM. (Motorola is aware of this issue.)

nCUBE implements a *cover stream* mechanism that fulfills the payload requirement and enables the set-top to tune low-bitrate data carousels. This cover stream is essentially an MPEG-2 black video stream encoded at 2.0 Mbps to meet the payload to null data ratio requirement.

For the ODA 2.3 release, the cover stream mechanism is dynamically allocated on the QAM as required. In other words, the cover stream is inserted into the QAM when no other MPEG video is playing. When other MPEG video is present, the cover stream is removed. By dynamically allocating the cover stream, the full bandwidth of the QAM is available for streaming video. Although the cover stream is necessary only if the QAM contains an initialization carousel, for design simplicity a cover stream is inserted into every narrowcast QAM.

ODA Client to ODA S rver Communication

The operation of the nCUBE VOD solution is driven by communication between the ODA server, a UDP server running on a Sun at the headend site, and an ODA client, running on a set-top box at a subscriber's house.

Service Group Auto-discovery Mechanism

The VOD operation depends on the ODA client's ability to:

- Start up when it is needed
- Independently discover the control data it needs to connect to the headend VOD system
- Obtain the movies or movie metadata the subscriber requires

The set-top box auto-discovery mechanism, based on the initialization carousel, enables ODA clients to do this. When a purchase occurs, and the headend system needs to know the ODA client's service group, the client reads the Service Group ID value from the initialization carousel.

VOD Session Initialization

When the subscriber launches VOD from the TVG interactive menu, the TV Guide Application notifies the ODA client that a new session has begun. At the beginning of a VOD session, the ODA client goes through this process to gain focus:

ODA Client Initializes

1. When the ODA client gains focus, it uses the TV Guide VOD source ID to access the initialization carousel and then tunes to that carousel.
2. From the carousel data stream, the ODA client extracts control data and caches this data. This includes the IP address of the ODA server and the home channel for the set-top box. (For a complete list of parameters, see *Initialization Carousel* on page 24.)

Client Connects to Server

3. Using the cached IP address and port number for the ODA server, the client opens a socket connection to the server.

Client Obtains Startup and Configuration Data

4. The ODA client sends the ODA server an out-of-band request for the current rental bookmark information for this subscriber, which is identified by the MAC address. The server pulls the information from the ODA database and returns it out-of-band.
5. The ODA client compares the current information with the rental bookmark information cached on the set-top box. If the bookmarks have changed, the ODA client sets a flag and caches the bookmarks on the set-top box.
6. Using the cached list of VCNs from the initialization carousel, the ODA client tunes to its home channel and finds the carousels containing the currently available movie metadata.

7. Once tuned, the ODA client selects the configuration carousel from the first MMC and obtains required startup information. The client retrieves the following metadata, and caches it on the set-top box.
   - MSO logo
   - Advertising graphics and associated text
   - Category index with VCNs for other MMCs and configuration information for all genre carousels within all MMCs
   - Package index of SVOD subscriptions

Client Confirms Beginning of Session

8. When the data scanning succeeds, the ODA client returns a begin session confirmation to the TV Guide Application.

Client Obtains Movie Metadata

9. The ODA client parses the startup information and passes it to the TV Guide Application. The initial category screen is displayed to the user.

The ODA client has now finished gaining focus. The client continues to operate, using its cached control data. Subsequent client/server communications, such as stream requests and dynamic metadata requests, take place out-of-band and are described in *ODA 2.3 Out-of-band Communications* on page 36.

Initial VOD User Navigation

The user navigation portion of the VOD session begins with this sequence of events:

1. The subscriber navigates the categories menu tree to a leaf category.
2. The ODA client begins to retrieve static movie metadata for titles in that leaf category and caches it on the set-top box. This metadata includes:
   - Categories to display
   - Asset titles
   - Asset details including rating, price, actors, and plot description
3. The ODA client receives a request from the TV Guide Application for the first screen of movie titles.
4. Using the cached the category index, the ODA client parses the movie title information and passes it to the TV Guide Application, which displays it to the subscriber.

Data Caching on the Set-top Box

The ODA client stores the data it extracts from the initialization carousel and the movie metadata carousel in DRAM on the set-top box. The ODA client uses the initialization data to report its service group to the nABLE bandwidth management application, and it uses the movie metadata cache to pass information to TV Guide Interactive application for the subscriber browsing experience.

Control Data Updates

The ODA client continues to use its dynamically acquired control data for a configured amount of time (typically 48 hours) or until the ODA client experiences an application error that resets the Plant ID Acquisition Flag. If the Plant ID Acquisition Flag is reset, initialization data acquisition will take place on the next begin session message from the TV Guide EPG.

Movie Metadata Cache

Movie metadata titles and asset descriptions are cached a few pages at a time.

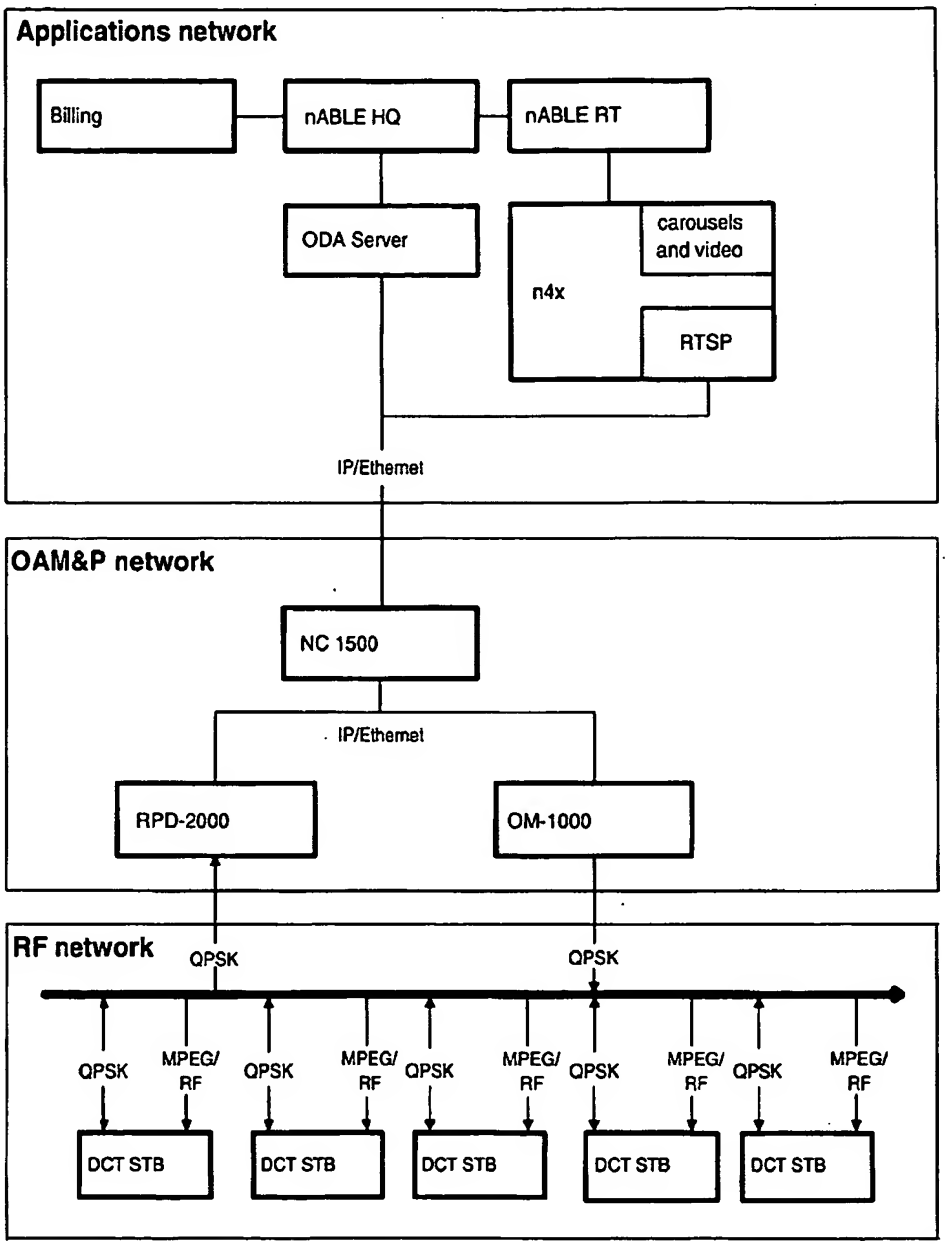
ODA 2.3 Out-of-band Communications

In the ODA 2.3 architecture, the out-of-band is used primarily for provisioning data communications, including:

- Set-top box firmware, TV Guide Interactive client, and nCUBE ODA client downloads to the set-top box
- All subscriber-specific (dynamic) data
- All session management messages (such as fast forward and rewind) between the set-top box and the nCUBE video server

Figure 2-10 provides a logical illustration of out-of-band communications in the nCUBE VOD Solution for TV Guide Interactive.

Figure 2-10: Out-of-band Communications: Logical View



Firmware and Client Application Downloads to the Set-top Box

Client applications are downloaded to the set-top boxes using the DAC 6000 management console application or the NDAC/UNDP for a NAS-based system. Essentially, the client application is loaded onto the DAC 6000, configured as an object, and pushed out to the DCT set-top boxes. (See Figure 1-6 on page 17.)

TV Guide Metadata

TV Guide Interactive Electronic Program Guide (EPG) data is sent out-of-band through the OM 1000. There are two sources of TV Guide metadata:

- Headend in the Sky (HITS)
- Live Feed Generator (LFG)

In either case, the guide metadata passes through the OM 1000 for out-of-band delivery to the TV Guide Interactive client.

nCUBE ODA 2.3 has been tested and integrated with both LFG and HITS.

Dynamic Data Communications

The TV Guide application notifies the ODA client when a provisioning request is made in the user interface. For example, a subscriber may navigate to the My Rentals page, which requires subscriber-specific (dynamic) data. Or the subscriber may make a purchase request, in which case session provisioning data is passed to the ODA server.

This is typically two-way communication, a series of requests and responses. It begins with this sequence of events:

1. The ODA client opens a connection to the ODA server on the first provisioning event that requires a communication with the ODA server. See *VOD Session Initialization* on page 33 for details.
2. The ODA server sends subscriber-specific movie metadata to the ODA client through the NC 1500.

   The NC 1500 routes the downstream communications from the ODA server to the client. The data is encapsulated in MPEG and sent via UDP.
3. The ODA client then receives this data on the socket it uses to listen for ODA server communications.
4. Subsequent provisioning and dynamic metadata communications between the ODA client and ODA server follow the same process.

The My Rentals List

The My Rentals page displays a list of dynamic, subscriber-specific rental data. The MSO can configure the list to display TVOD titles, SVOD titles, or both. Because the list is implemented as a category, the MSO can opt to set up separate subcategories for TVOD and SVOD rather than displaying all the titles in one list. The names of the My Rentals category and subcategories are also configurable. Up to 50 titles can appear in My Rentals. If more than 50 are purchased, the titles most recently viewed are maintained in the list. Purchased TVOD titles appear on the list for the length of their allowed viewing time, and SVOD titles are listed

for 24 hours. Subscribers can remove titles from My Rentals to shorten the list or hide a purchase, but this does not change the rental status of the titles in the system.

If a title that a subscriber is qualified to view does not appear in My Rentals for some reason, it is still accessible through other VOD screens. For the duration of the TVOD rental window or the SVOD viewing window, the title still appears with a check mark in the VOD listing and has the rented information screen. The subscriber can view the asset without paying any additional charge.

Rental Data Storage

The ODA server maintains a database of rental records for all its set-top boxes, but each ODA client also maintains its own rental data on the set-top box. Thus, under normal circumstances, it is not necessary to update the My Rentals list from the ODA server database.

The rental data for each account is maintained as *rental bookmarks*, a list of all the assets this subscriber is qualified to view. Each entry in the list is a *rental token* containing the data that the ODA server needs to set up viewing of an asset. The asset IDs in the list are linked to a collection of *rental detail* records containing, among other things, the data displayed on the rented information screen.

Keeping Rental Data in Sync

At session initialization, the ODA client sends a *rental bookmarks* request, and the ODA server returns a small message containing the tokens for each rental for this account. If the server's list is different from the client's list, the client sets a flag. The client caches the updated bookmarks. If the client has rental details in memory for each of the asset IDs on the list, no more client-server communication is required.

If the ODA client does not have rental details for all the asset IDs, it displays the titles for which it does have details at the top of the My Rentals list. As the subscriber pages down, the client sends a *rental details* request to the server for the next seven asset IDs. Thus, the client always has the rental detail information for the titles on the next screen.

At session teardown, if the subscriber has requested any assets for which rental details do not exist on the set-top box, the ODA client sends a rental details request, if necessary, to ensure that it has details for the assets that will appear on the first screen of My Rentals.

Handling Multiple STBs

In households with multiple set-top boxes, as long as a title is checked it cannot be purchased again, even if it is deleted from My Rentals. Subsequent purchases can occur only after the title expires. The rental bookmarks mechanism is used to keep the rental information in sync on all the set-top boxes.

Each STB has its own MAC address, but all the MAC addresses are attached to the same account, so the ODA server sends identical information to each STB. Thus, a viewer can watch a program on the downstairs STB, stop it, and restart it from the same point on the upstairs STB. When the VOD session begins upstairs, the STB has no record of the downstairs purchase in its memory. Through the rental bookmarks and rental details message sequence, however, the ODA client receives full data on the stopped viewing session, including the media position that the ODA server received from the downstairs client during teardown of the earlier session.

Data Storage Formats

A database on the ODA server's host stores the movie metadata and control data that the ODA server uses to build the carousels.

Movie Metadata: An Analysis

Within the movie metadata itself, each asset is approximately 565 bytes, stored in the ODA database in the following format:

```
typedef struct _VOD_VideoInfo
{
unsigned short versionId; (2)
unsigned long assetID; (4)
VOD_AssetRating rating; (2)
unsigned char title[MAX_ASSET_SHORT_TITLE_LENGTH]; (25)
VOD_AssetType assetType; (2)
unsigned char longTitle[MAX_ASSET_LONG_TITLE_LENGTH]; (40)
char priceInfo[MAX_PRICE_LENGTH]; (32)
unsigned long runTime; (4)
unsigned long viewingWindow; (4)
unsigned long rentalWindow; (4)
unsigned long freeWindow; (4)
unsigned long providerAssetID; (4)
unsigned long parentAssetID; (4)
unsigned long assetFlags; (4)
VOD_Date dateAvailable; (4)
unsigned short yearOfRelease; (2)
unsigned char *description; (400)
unsigned long suspendedPosition; (4)
unsigned long rentalTimeRemaining; (4)
unsigned long viewingTimeRemaining; (4)
unsigned long runTimeRemaining; (4)
unsigned long packageAssetID; (4)
unsigned long previewAssetID; (4)

}VOD_VideoInfo;

Total = 565
```

Mathematically then, a 500-movie database would contain approximately:

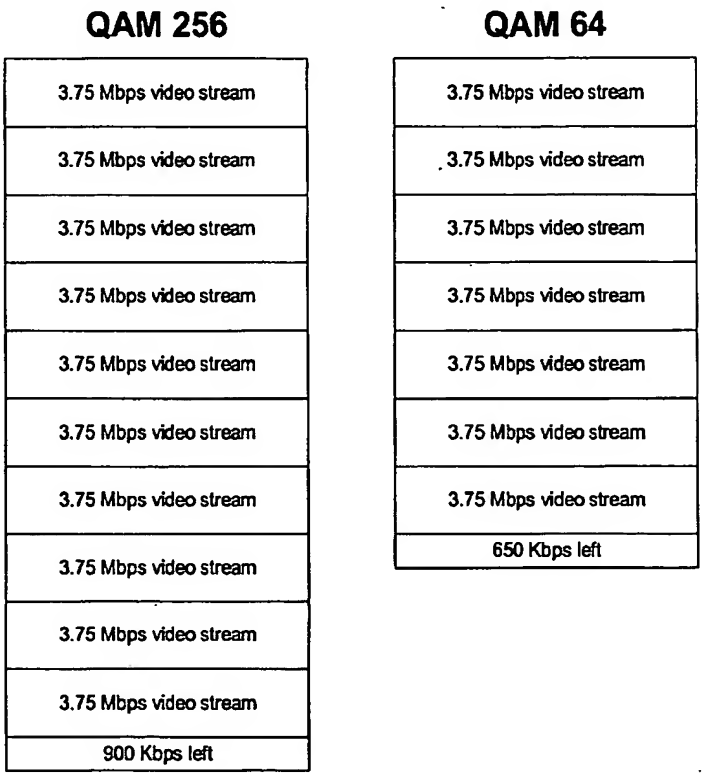
```
565 bytes x 500 = 282,500 bytes
```

Not all movies will require the complete movie metadata record space. In fact, a typical movie metadata record would consume less than ½ of the available record space. (Note that in any case sending more movie metadata requires more bandwidth and/or greater latency while the client receives the data.) Our carousel solution fits both equations, providing the appropriate solution for the specific customer requirements.

Even at lower bitrates the DCT 2000 drops DC2TEXT messages, and so a carousel must loop often. Looping the data multiple times within the carousel solves this problem.

As more genre slices are added to the movie metadata file, more bandwidth must be consumed, thus displacing one video stream per narrowcast service group.

Figure 2-11: Bandwidth Usage in Narrowcast QAMs



Initialization Carousel Data Format

The control data in an initialization carousel is stored in the following format:

```
/* TSID, Program Number, VCN Def */
typedef struct
{
UI16 ui16TSID ; /* TSID */
UI16 ui16Pnum ; /* Program Number */
UI32 DestVCN ; /* Corresponding Virtual Channel Number */
} DestInfo_S ;
/* Init Carousel Definition - Plant ID T4 */
typedef struct
{
UI32 ui32PlantID ; /* Cable Plant identifier */
UI32 ui32VCNa ; /* Carousel set A */
UI32 ui32VCNb ; /* Carousel set B */
UI32 ui32HomeBarkerVCN ; /* VCN to tune to after data
      acquisition is complete*/
UI8 aui8ErrString[128] ; /* shrunk from 400 */
UI16 ui16DebugMask ; /* bit - 0 debug
                      * bit -1 to 15 reserved */
UI16 ui16UpHb ; /* Upstream Heartbeat Timeout */
UI16 ui16DnHb ; /* Downstream Heartbeat Timeout */
UI32 ui32ODAS_ip ; /* ODA Server IP Address */
UI16 ui16ODAS_port ; /* ODA Server Port Number */
UI32 aui32RTSP_ip[4] ; /* RTSP Server List - RTSP Server
      port will always be assumed to be 554 - unused
      array entries will be 0xFFFFFFFF */
DestInfo_S DestTable[100] ; /* Get VCN from destination
string */
} Init_S ;
```

Heartbeat

Two-way heartbeat ensures the reliability of the distributed VOD solution during a viewing session. The downstream transport heartbeat mechanism provides resume functionality and a reliable means for the client to detect end-of-stream and stream errors. The upstream heartbeat mechanism provides a way for the video server to detect errors in the set-top box.

Transport Heartbeat

Transport heartbeats are specifically formatted DC2TEXT messages that are embedded into movie content at tag time on the nCUBE video server, typically at the rate of two per second. The ODA client requires a heartbeat message at least once every 17 seconds. These transport heartbeat DC2TEXT messages contain information relating to the current position of the video file.

The ODA client uses transport heartbeat message for three reasons:

1. Transport heartbeat messages report the viewer's current position in the media. When the session is terminated, the last acquired media position is stored in the ODA server so that the user can later resume the media from this last known position.
2. The ODA client uses transport heartbeat messages to ensure that a constant stream of media is entering the set-top box and being displayed to the user. If for some reason the media flow to the set-top box is interrupted for a pre-defined length of time, the ODA client will tear down the session and return the viewer to the TV Guide Interactive User Interface.
3. The media position the ODA client extracts from transport heartbeat is used to determine the media position relative to the beginning and ending of the media. This allows the ODA client to prevent the user from running over either end of the media during a session.

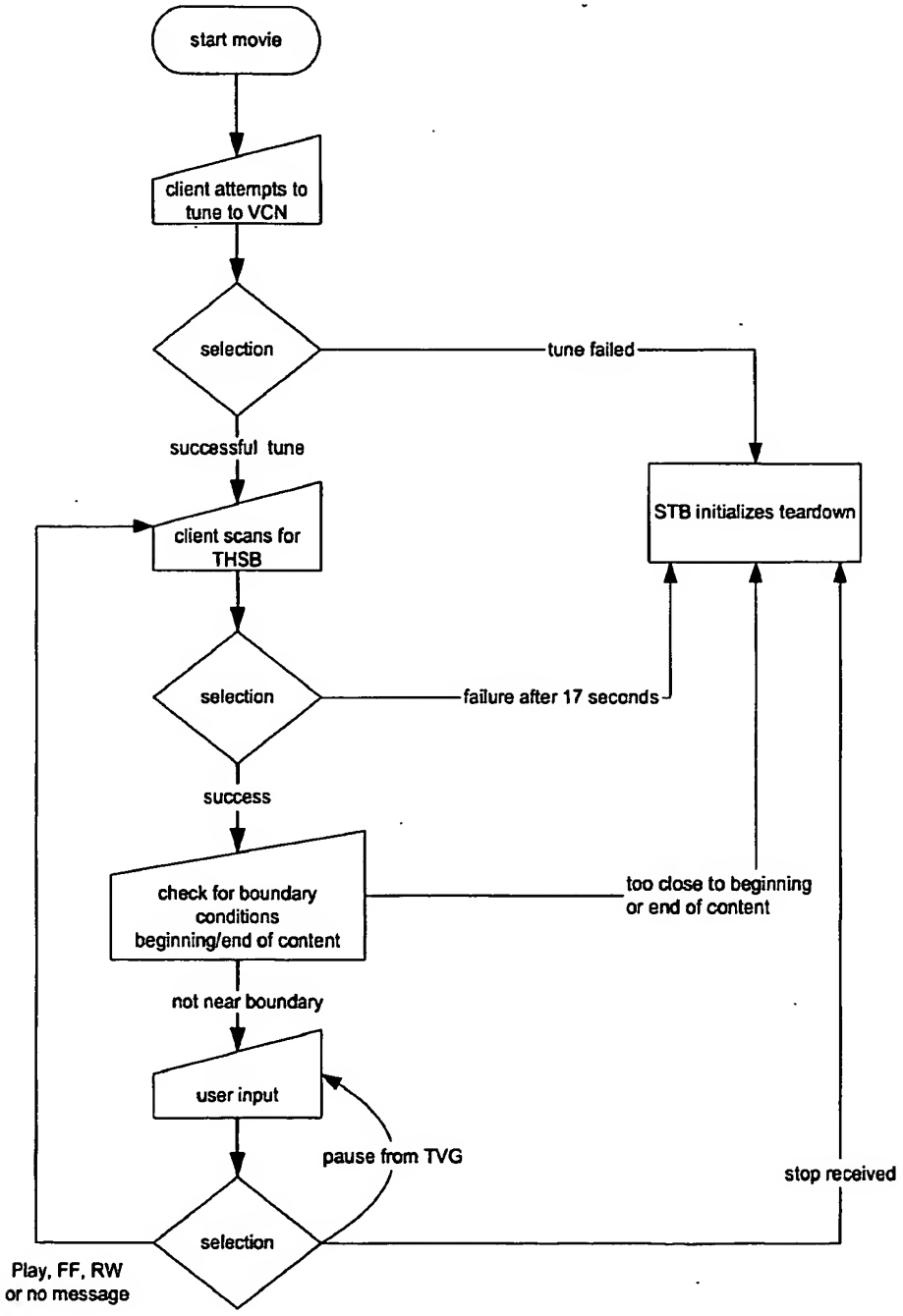
Figure 2-12 illustrates the downstream transport heartbeat mechanism.

Upstream Heartbeat

The ODA client sends UDP/IP packets to the nCUBE video server at regular intervals, confirming that the client is running normally on the set-top box and successfully consuming the video stream. Upstream heartbeat is sent at a configurable interval, typically every 5 minutes. If for some reason the set-top box does not respond for a pre-defined length of time, the video server stops streaming. For additional details, see *Transport Heartbeat* on page 74.

Heartbeat timeouts are specified in the initialization carousel; see *Initialization Carousel* on page 24 and *Initialization Carousel Data Format* on page 42 for more information.

Figure 2-12: Downstream Transport Heartbeat Checking Flow



Chapter 3: VOD Products

This chapter describes the kinds of VOD products that MSOs can make available to their subscribers and how to set up the different products.

Types of Video-on-Demand Assets

The nCUBE VOD Solution for TV Guide supports three types of video assets, including:

- Subscription VOD (SVOD). Viewers purchase SVOD subscriptions for a recurring monthly charge.
- Transactional VOD (TVOD). Viewers are charged each time they rent a title.
- Free on demand (FOD). Viewers are not charged for these videos, such as help videos and barkers.

The VOD solution has been tested with as many as 2000 assets, including 1000 TVOD assets.

Subscription VOD

SVOD subscriptions are categories of assets packaged into a single purchasable item for a recurring monthly charge. The viewer can play any titles offered that month any number of times for the same fee.

Each subscription includes a set of categories and subcategories whose assets change every month. For example, a subscription could have these categories and subcategories:

Blockbusters

Action
Drama

Classics

1930s
1940s
...

Every month, a different selection of titles appears in, say, the Action category. The categories are automatically read from the metadata provided by the content providers, but an MSO can also create its own categories in nABLE.

The nCUBE solution supports premium SVOD (sometimes called contingent SVOD) as well as basic SVOD. For example, to purchase the HBO on Demand package, a customer can be required to first subscribe to HBO as a broadcast package. The provisioning system would enforce this rule.

SVOD Setup Process

Individual assets are assembled into an SVOD subscription using nABLE HQ. The operator creates a package and then links individual assets to that package. The system can be configured so that metadata coming in from a particular provider is automatically associated with a particular package.

nABLE outputs the resulting metadata in an XML file containing both TVOD and SVOD metadata, distinguished by different data fields. The ODA server stores it in its database on the ODA server host. The server also generates a configuration carousel containing the metadata, including the package index of SVOD subscriptions. That index is one piece of information the ODA client extracts at startup.

SVOD Runtime Operation

As a viewer browses, the TV Guide EPG matches the package ID of an asset with the list of entitled package IDs for this set-top box. If the viewer is entitled to the package that corresponds to an asset, the asset is displayed with a Watch button. If the viewer is not entitled to the package that corresponds to an asset, the asset is displayed with a Buy button.

When the viewer selects an SVOD subscription, the ODA client compares its list of SVOD entitlement IDs, which it acquired via the rental bookmarks message, against the ID of the subscription that this asset belongs to. If a match is found, the set-top box knows it is entitled to the asset. If a match is not found, the viewer can subscribe to the SVOD package and view it immediately. The ODA client sends a purchase request, which eventually goes to the SVOD billing and provisioning vender for the current set-top box. For details on FOD runtime events, see *User Navigation* on page 60, *Posting a TVOD Billing Event* on page 61, and *Session Setup - Viewing of SVOD Asset* on page 69.

The My Rentals list usually contains both the TVOD rentals and SVOD subscriptions for this viewer account, although the MSO can limit the list to one type or the other. SVOD titles appear on the list for 24 hours. Subscribers can remove packages from the My Rentals list, but this does not change their subscription status.

Up-sell Options

The nCUBE VOD solution supports both offline and online up-sell to SVOD.

Online Up-sell

When a viewer is buying a TVOD title, the ODA server checks both the product information and the provisioning information in its database. If that title is also available as part of a package or SVOD subscription, an up-sell message appears, giving the option to buy the package or subscription instead.

The MSO can configure up-sell behavior. Normally, there is a grace period, which allows immediate viewing while the MSO gets provisioning information into the system. The grace period is equal to the package rental duration configured in nABLE. When the grace period is over, the ODA server begins checking the provisioning information and either allows viewing, if the viewer is entitled to the package, or offers upsell again, if the viewer is not entitled.

Offline Up-sell

Offline up-sell is also supported via the CSG API or the Motorola SVOD Authorization API.

SVOD Deletion Proc ss

The ODA server provides an automatic delete service for SVOD packages sold through online upsell. After the grace period, if the provisioning information does not show that the account is entitled to a package, the ODA server deletes it from the account. When the viewer selects the package, the upsell screen is displayed again.

Subscribers can cancel their SVOD subscriptions by calling the cable company. The cancellation is entered directly into the provisioning system.

When a cable operator stops offering a particular SVOD subscription to viewers, the option is removed from the system using nABLE HQ. nABLE sends the information to the ODA server, which updates its database. At the next VOD session, the option no longer appears in the list of available packages. The operator cancels the monthly charges for the current subscribers through the provisioning system.

Transaction VOD

TVOD assets are purchased at the time of viewing. Titles are available to the viewer for a length of time determined by agreement between the operator and the content provider. During that time, the titles appear on the My Rentals list, where viewers make their selection. Viewers are charged when they purchase a title.

Purchasing a title enables the viewer to check it out and view it for a pre-determined length of time. This time is configured by the operator.

TVOD Runtime Operation

As a viewer browses, the TV Guide EPG matches the ID of an asset with the list of entitled asset IDs for this set-top box. If the viewer is entitled to the asset, the asset is displayed with Resume and Restart buttons. If the viewer is not entitled to the package that corresponds to an asset, the asset is displayed with a Buy button.

When the viewer selects a TVOD subscription, the ODA client compares its list of TVOD entitlement IDs, which it acquired via the rental bookmarks message, against the ID of this asset. If a match is found, the set-top box knows it is entitled to the asset. If a match is not found, the viewer can purchase the asset now. The ODA client sends a purchase request, which eventually goes to the TVOD billing and provisioning vender for the current set-top box. For details on TVOD runtime events, see *User Navigation* on page 60, *Posting a TVOD Billing Event* on page 61, and *Session Setup - Viewing of SVOD Asset* on page 69.

The My Rentals list usually contains both the TVOD rentals and SVOD subscriptions for this viewer account, although the MSO can limit the list to one type or the other. Purchased TVOD titles appear on the list for the length of their allowed viewing time. Viewers can remove titles from the My Rentals list, but this does not change their rental status.

TVOD Deletion Process

TVOD titles are removed from the My Rentals list through two mechanisms:

- **By the viewer.** If a viewer does not want to see a title on the My Rentals list, selecting the title and pressing the Delete button removes it from the user interface. This is not a delete from the system, and it doesn't affect billing. The title remains in the set-top box cache and the ODA server database. If the viewer later requests to purchase that title, the ODA server knows whether it is a new purchase or a replay and handles it appropriately.
- **By the operator.** When the operator stops offering an asset to viewers, the title is removed from the system using nABLE HQ. nABLE HQ sends the information to the ODA server, which updates its database. At the next VOD session, the title no longer appears in the list of available titles or the My Rentals list. This is a true delete from the system.

For more details on viewer deletions, see *Deleting a TVOD Asset* on page 77.

FOD Assets

FOD assets are viewable without a subscription or a billing transaction. FOD content can include barkers, help videos, and short features. When a viewer selects an FOD title, no record is kept, and the FOD title does not appear in the My Rentals list.

When the operator stops offering an FOD asset to viewers, the title is removed from the system using nABLE HQ. The ODA does not keep viewing records for FOD assets, so nABLE does not forward any information to the ODA server. If the asset was a title that could be selected for viewing, at the next VOD session the title no longer appears in the list. If it was a barker, another preview appears in its place.

Chapter 4: Purchasing and Billing

This chapter describes:

- VOD assets available for purchase
- Purchasing, provisioning, billing, and deleting TVOD assets .
- Purchasing, provisioning, billing, and deleting SVOD assets

VOD Assets Available for Purchase

The nCUBE VOD Solution for TV Guide offers a choice of three types of video assets, TVOD, SVOD, and FOD. Because FOD does not involve a purchase transaction, this chapter discusses only TVOD and SVOD.

TVOD Purchase and Billing

TVOD assets are purchased at the time of viewing. Titles are available to the viewer for a length of time determined by agreement between the operator and the content provider. Viewers are charged when they purchase a title.

TVOD Purchasing and Provisioning Process

Purchasing a title enables the viewer to check it out and view it for a pre-determined length of time. This time is configured by the operator.

nODA 2.3 supports real-time billing and provisioning for TVOD titles. The provisioning data comes from the MSO to nABLE, which converts the various provisioning vendors' formats to a standard format and passes it to the ODA server. The server stores the data and uses it to provision subscribers.

In the typical real-time environment, a purchase requires this sequence of events:

1. The purchase request goes from the EPG user interface to the ODA client
2. The client passes the request to the ODA server.
3. The ODA server checks its records to confirm that the viewer has not already purchased the title and then sends the billing event to nABLE HQ.
4. nABLE HQ checks which billing system the charge is going to and requests provisioning information from the billing system.
5. The billing system sends confirmation to nABLE HQ that the set-top box is associated with an account that is entitled to purchase certain titles.
6. nABLE HQ outputs the billing data in the appropriate format and sends it on to the billing system.

If the ODA server finds that the viewer has already purchased the title, the server returns restart information directly to the ODA client and does not contact the billing system.

For installations that use Convergys ICOMS billing services or file-based billing, the process is slightly different. See *Posting a TVOD Billing Event* on page 61 and *Session Setup - Viewing of SVOD Asset* on page 69 for more details on TVOD purchases.

Up-sell Option

If a subscriber is buying a TVOD title that is also available as part of a package or SVOD subscription, an up-sell message appears, giving the option to buy the package or subscription instead.

Supported Options for TVOD Provisioning and Billing

The nCUBE VOD solution for TV Guide supports billing for VOD purchases through CSG Systems, DST Innovis, and Convergys ICOMS.

Individual set-top boxes can be assigned to different billing system types. For example, box 123 can post billing transactions in CSG format while box 456 posts to DST. The ODA server posts billing transactions to the nABLE Billing and Provisioning Service (BPS), which maps the billing requests to the different billing systems.

Table 4-1 lists the TVOD billing solutions.

Table 4-1: TVOD Billing Systems

Vendor	Solution	Type	Details
CSG	real-time	socket-based	Data sent to nABLE billing service via nCUBE billing service interface. Specification: CSG Video on Demand Provisioning Interface Version 1.1
	just-in-time	file based	Data output to an XML billing file. Supported via the nABLE billing service. Specification: CSG Video on Demand Provisioning Interface Version 1.1
DST Innovis	real-time	socket-based	DST BAA
	just-in-time	file-based	DST RAMPS
	just-in-time	file-based	DST DDP/SQL
Convergys ICOMS	real-time	socket-based	Convergis ICOMS 4.5. Specification: ICOMS 4.5 API
Great Lakes	real-time	socket-based	Specification: Great Lakes VOD File Formats Revision 1.02, 6/30/03

TVOD provisioning is supported through the following provisioning solutions:

Table 4-2: TVOD Provisioning Systems

Vendor	Solution	Type	Details
CSG	real-time	socket-based	Data gets to nODA via nCUBE billing service interface. Specification: CSG Video on Demand Provisioning Interface Version 1.1.
	just-in-time	file-based	CSG nCUBE. Specification: nCUBE File Provisioning API Version 1.3.1
DST Innovis	just-in-time	file-based	DST nCUBE. nCUBE API integration required. Specification: nCUBE File Provisioning API Version 1.3.1
Convergys ICOMS	just-in-time	socket-based	Convergys ICOMS 4.5. Just-in-time provisioning based on socket-based billing interface. Specification: ICOMS 4.5 API
Great Lakes	real-time	socket-based	Specification: Great Lakes VOD File Formats Revision 1.02, 6/30/03

SVOD Purchase and Billing

SVOD subscriptions are categories of assets packaged into a single purchasable item for a recurring monthly charge. The viewer can play any titles offered that month any number of times for the same fee.

SVOD Purchase and Provisioning Process

Because SVOD is an ongoing subscription service, SVOD assets can be purchased two ways: through a call to the cable company or through the EPG user interface.

Telephone Purchase

Subscribers can call the cable company directly (perhaps in response to a flier). They are provisioned in an offline format via the CSG API or the Motorola SVOD Authorization API. In an installation using the Motorola API, for example, provisioning follows this sequence:

1. The cable operator enters the viewer and billing data into their provisioning system.
2. The provisioning system sends a notification to the DAC 6000 that a specific subscriber has purchased a specific package.
3. The DAC translates that package ID into a *service handle*, which is the number used by the billing system to define a package. Once a service handle and customer ID are known, the DAC generates an XML file and deposits it in a well-known directory.
4. nABLE HQ checks the directory for provisioning data at regular intervals.
5. nABLE passes the data on to the ODA server so the subscriber's set-top box can be authorized.

EPG UI Purchase

In the EPG user interface, SVOD appears side-by-side with TVOD. For example, the main VOD page may contain a Movies category that displays the My Rentals list of TVOD titles and a Hollywood on Demand button that represents an SVOD subscription. In the typical real-time environment, when a viewer clicks on Hollywood on Demand and browses through a few screens of information about the subscription, it launches this sequence of events:

1. The viewer browses through SVOD categories and finds a title to watch
2. The set-top box checks its entitlement list (which was acquired through the rental bookmarks request) to determine if the viewer is already entitled to view the title.
3. If the viewer is entitled to view the title, the screen provides the option to watch.
4. If the viewer is not entitled to view the title, the screen provides the option to buy.
5. If the viewer presses the Buy button, the ODA client sends a purchase request to the ODA server.
6. The ODA server sends the billing event to nABLE HQ.
7. The program begins playing.

Up-sell From TVOD

If a subscriber is buying a TVOD title that is also available as part of an SVOD subscription, an up-sell message appears, giving the option to buy the package or subscription instead.

Supported Options for SVOD Up-sell and Provisioning

The nCUBE VOD solution for TV Guide supports interactive up-sell from TVOD to SVOD through the CSG and Great Lakes billing systems.

Table 4-3: Support for Interactive Upsell to SVOD by Billing Systems

Vendor	Solution	Type	Up-sell	Details
CSG	real-time	socket-based	yes	Data sent to nABLE billing service via nCUBE billing service interface. Specification: CSG Video on Demand Provisioning Interface Version 1.1
	just-in-time	file based	no	Data output to an XML billing file. Supported via the nABLE billing service. Specification: CSG Video on Demand Provisioning Interface Version 1.1
DST Innovis	real-time	socket-based	no	DST BAA
	just-in-time	file-based	no	DST RAMPS
	just-in-time	file-based	no	DST DDP/SQL
Convergys ICOMS	real-time	socket-based	no	Convergis ICOMS 4.5. Specification: ICOMS 4.5 API
Great Lakes	real-time	socket-based	yes	Specification: Great Lakes VOD File Formats Revision 1.02, 6/30/03

SVOD provisioning is supported through CSG Systems, Great Lakes, and the Motorola SVOD Authorization API.

Table 4-4: SVOD Provisioning Systems

Vendor	Solution	Type	Details
CSG	real-time	socket-based	Data sent to nABLE billing service via nCUBE billing service interface. Specification: CSG Video on Demand Provisioning Interface Version 1.1
	just-in-time	file-based	CSG API
DST-Innovis	just-in-time	file-based	Motorola SVOD Authorization API
Convergys ICOMS	just-in-time	file-based	Motorola SVOD Authorization API
Great Lakes	real-time	socket-based	Specification: Great Lakes VOD File Formats Revision 1.02, 6/30/03

Chapter 5: System Event Communication Flow

This chapter provides descriptions of the communication flow for VOD system events.

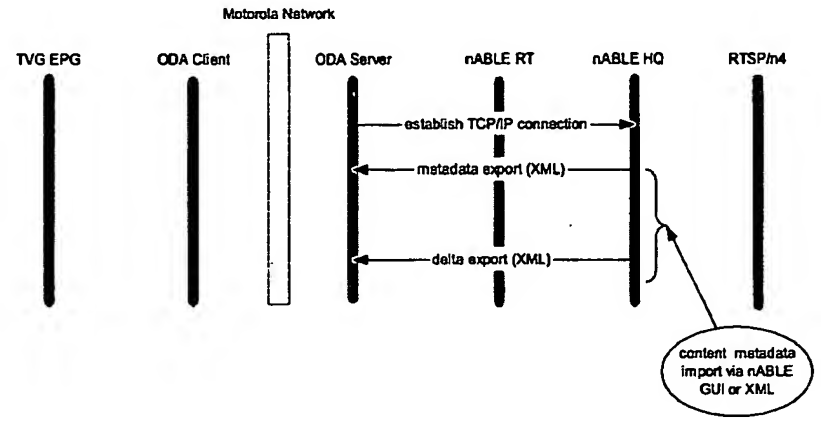
The VOD system events documented include:

- ODA Metadata Update
- ODA Client Update
- Initiating a VOD Session
- User Navigation
- Posting a TVOD Billing Event
- Posting an SVOD Billing Event
- Session Setup - New TVOD Purchase
- Session Setup - First Viewing of SVOD Asset
- Session Setup - Resume Playing an Asset
- Stream Control Operation
- Downstream and Upstream Heartbeat
- Session Teardown - End of Stream, Pause Limit Reached, or Stop
- Deleting a TVOD Asset

ODA Server Subscriber Metadata Update

Trigger	Event	IB/ OOB	Type
Update ODA metadata collection	On startup, ODA server establishes TCP/IP socket with nABLE HQ.	n/a	TCP
	nABLE HQ sends complete subscriber metadata collection for TVOD, SVOD, and FOD assets to ODA server.	n/a	TCP
	At a configured interval or manually, nABLE HQ sends delta updates to ODA server.	n/a	TCP

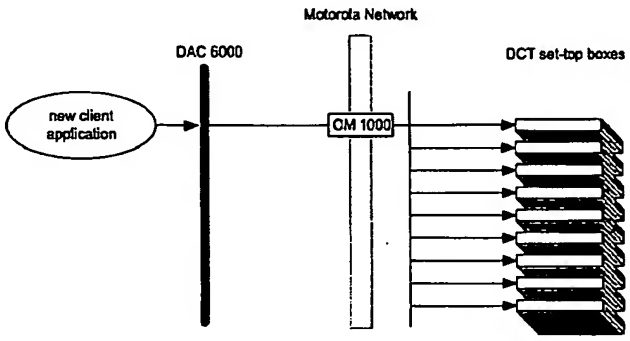
Figure 5-1: ODA Server Metadata Update



TV Guide Interactive/nCUBE ODA Client Update

Trigger	Event	IB/ OOB	Type
Client application object is downloaded onto the DAC 6000.	DAC 6000 updates all DCT set-top boxes via multicast.	OOB	UDP

Figure 5-2: Client Updates on DCT Set-top Boxes

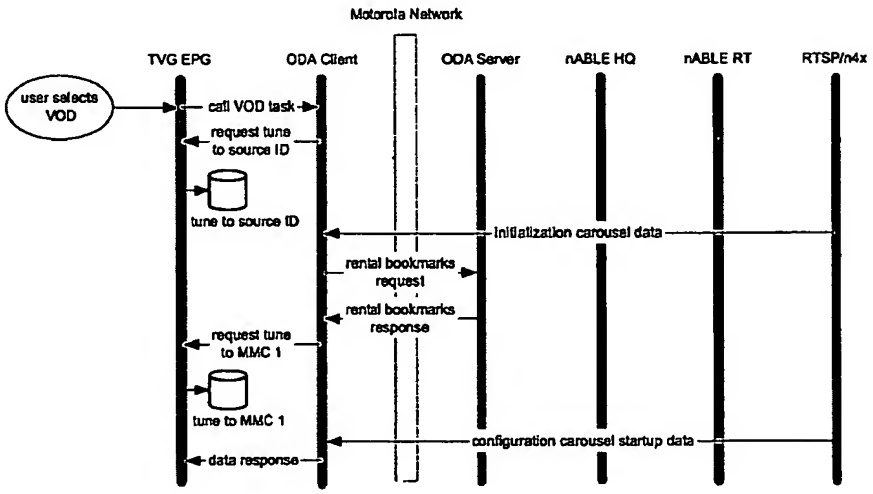


Initiate VOD Session

Trigger	Event	IB/ OOB	Type	Notes
User selects VOD.	TV Guide sends VOD task request to ODA client.	n/a	n/a	
	ODA client returns a request for TV Guide to tune the TV Guide VOD source ID.	n/a	n/a	
	TV Guide tunes source ID.	n/a	n/a	
	ODA client accesses the initialization carousel, extracts the initialization data and caches it. • Service group ID • Home and backup channel VCNs • IP address of its ODA server • IP addresses for its RTSP servers • VCN-Mux ID channel map • Error string for purchase failures • Heartbeat intervals	IB	DC2T EXT	The client uses this initialization data until (1) a configured amount of time passes (typically 48 hours) or (2) the set-top box's power is disconnected or (3) the client experiences errors in the VOD session
	ODA client opens a socket and requests its current rental bookmarks.	OOB	UDP	
	ODA server returns the current rental bookmark information.	OOB	UDP	
	ODA client compares current information with the rental bookmarks cached on the set-top box. If the bookmarks have changed, the ODA client sets a flag. The client caches the current bookmarks.	n/a	n/a	
	ODA client sends a request for TV Guide to tune to its home channel (MMC 1).	n/a	n/a	
	TV Guide tunes to the home channel.	n/a	n/a	

Trigger	Event	IB/ OOB	Type	Notes
	ODA client accesses its configuration carousel in MMC 1, extracts the required startup information, and caches it. • MSO logo • Advertising graphics • VCNs for other MMCs • Package index of SVOD subscriptions • Configuration information for all genre carousels within all MMCs.	IB	DC2T EXT	
	ODA client returns a begin session confirmation to the TV Guide application.	n/a	n/a	

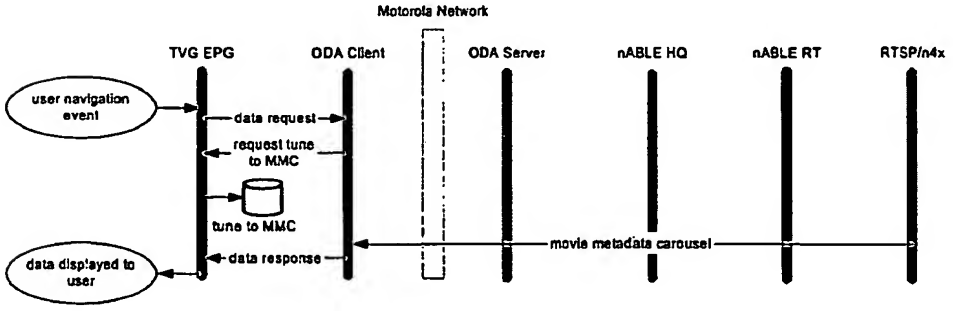
Figure 5-3: Initiate VOD Session



User Navigation

Trigger	Event	IB/ OOB	Type
User navigates VOD user interface and views static metadata.	TV Guide makes request of ODA client for metadata to provide the user with VOD information.	n/a	n/a
	ODA client returns a request for TV Guide to tune to the MMC VCN.	n/a	n/a
	TV Guide tunes to the VCN of the MMC.	n/a	n/a
	ODA client accesses the movie metadata carousel in the MMC, extracts the metadata, and caches it.	IB	DC2TEXT
	ODA client hands over the requested metadata.	n/a	n/a
	TV Guide displays the VOD information to the user.	n/a	n/a

Figure 5-4: User Navigation Event



Posting a TVOD Billing Event

Trigger	Event	IB/ OOB	Type
User purchases an asset.	TVG EPG issues a purchase request to the ODA client.	n/a	n/a
	ODA client sends the purchase request to the ODA server.	OOB	UDP
	For installations using ICOMS billing services, the ODA server checks that the customer is entitled to make a purchase:		
	• ODA server sends a provisioning request to the nABLE HQ.	n/a	TCP
	• nABLE billing server sends a provisioning request to ICOMS.	n/a	TCP
	• ICOMS returns a provisioning response to nABLE billing server.	n/a	TCP
	• nABLE billing server returns the provisioning response to ODA server.	n/a	TCP
	ODA server checks if the asset is already purchased.	n/a	n/a
	ODA server sends the billing message via XML over TCP to nABLE HQ.	n/a	TCP
	If real-time billing, nABLE billing server sends a billing message to billing service. If file-based billing, nABLE HQ outputs the appropriate format: • Vendor-specific file format • Message to vendor billing system • nCUBE XML File Format	n/a	TCP
	If real-time billing, nABLE billing server returns a billing response to the ODA server. (If file-based billing, there is no response.)	n/a	TCP
	ODA server returns purchase response to the ODA client.	OOB	UDP

Figure 5-5 shows the TVOD billing process for all billing services except ICOMS.

Figure 5-5: Posting a TVOD Billing Event

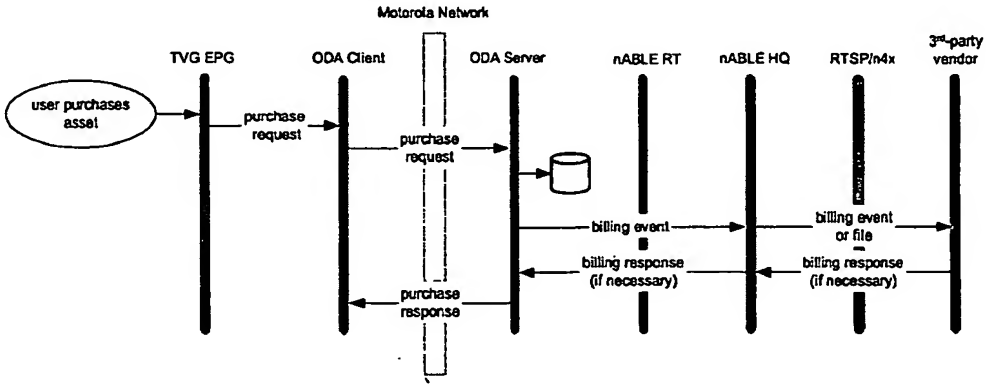
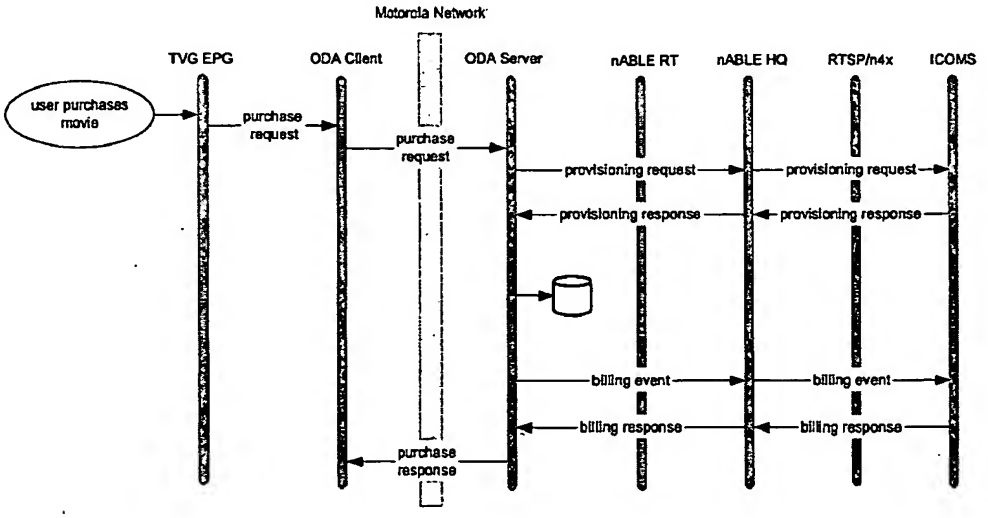


Figure 5-6 shows the TVOD real-time provisioning and billing process for ICOMS.

Figure 5-6: Posting a TVOD Billing Event for ICOMS Billing



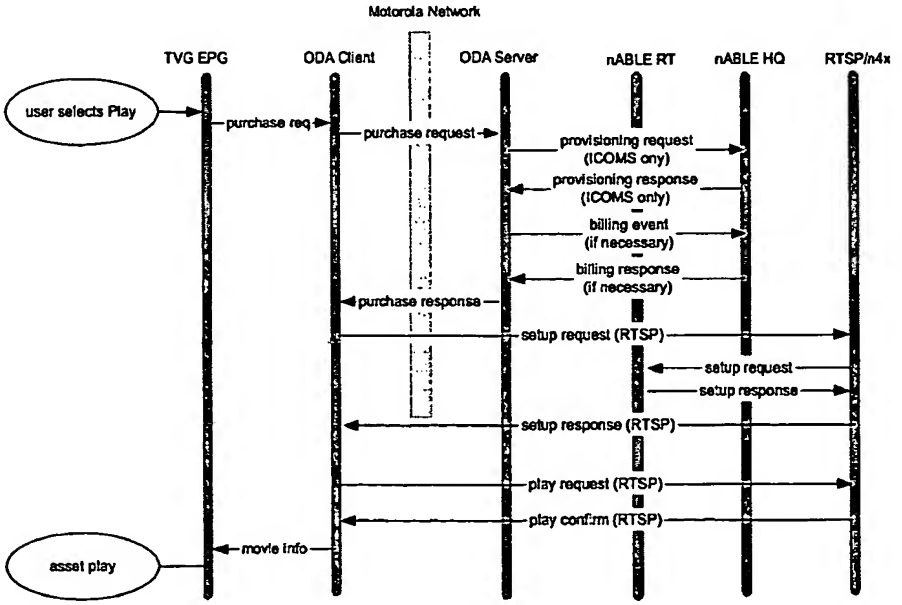
Note: The operator can configure the response to be taken when ICOMS does not recognize the account that is making the purchase request. The system can refuse the purchase, or it can allow the purchase and log the transactions as usual.

Session Setup - New TVOD Purchase

Trigger	Event	IB/ OOB	Type	Notes
User purchases an asset.	TVG EPG issues a purchase request to the ODA client.	n/a	n/a	
	ODA client sends the purchase request to the ODA server.	OOB	UDP	
	ODA server handles the purchase request and determines that the user does not have access to the same title within a prepaid SVOD subscription.	n/a	n/a	
	For installations using ICOMS billing services, the ODA server communicates with nABLE HQ, which confirms provisioning with ICOMS.	n/a	TCP	
	ODA server communicates with the nABLE billing server.	n/a	TCP	
	If real-time billing, nABLE billing server returns a billing response to the ODA server. (If file-based billing, there is no response.)	n/a	TCP	
	ODA server returns the session information to the ODA client necessary to set up the program.	OOB	UDP	
	ODA client sends a session setup request with the service group ID to the RTSP server.	OOB	RTSP	
	RTSP server assigns a session ID and sends the request to nABLE RT.	n/a	RTSP	
	nABLE RT assigns the Pump ID and Mux ID for the session and sends these to the RTSP server.	n/a	RTSP	
	RTSP server sends the Mux ID and program number to the ODA client.	OOB	RTSP	

Trigger	Event	IB/ OOB	Type	Notes
	ODA client translates the Mux ID and program number to a VCN, using the cached channel map.	n/a	n/a	
	ODA client submits play command to RTSP server.	OOB	RTSP	
	RTSP server sends confirmation message.	OOB	RTSP	
	Video server begins to stream the session.	IB	MPEG -2	
	ODA client attempts to tune to the VCN and notifies TV Guide to begin the session.	n/a	n/a	
	TV Guide client removes the EPG user interface and shows the program (fail case = error message).	n/a	n/a	MPEG file includes the transport heartbeat, which acts as a keep-alive mechanism during the video stream.

Figure 5-7: TVOD Session Setup



Up-sell to SVOD

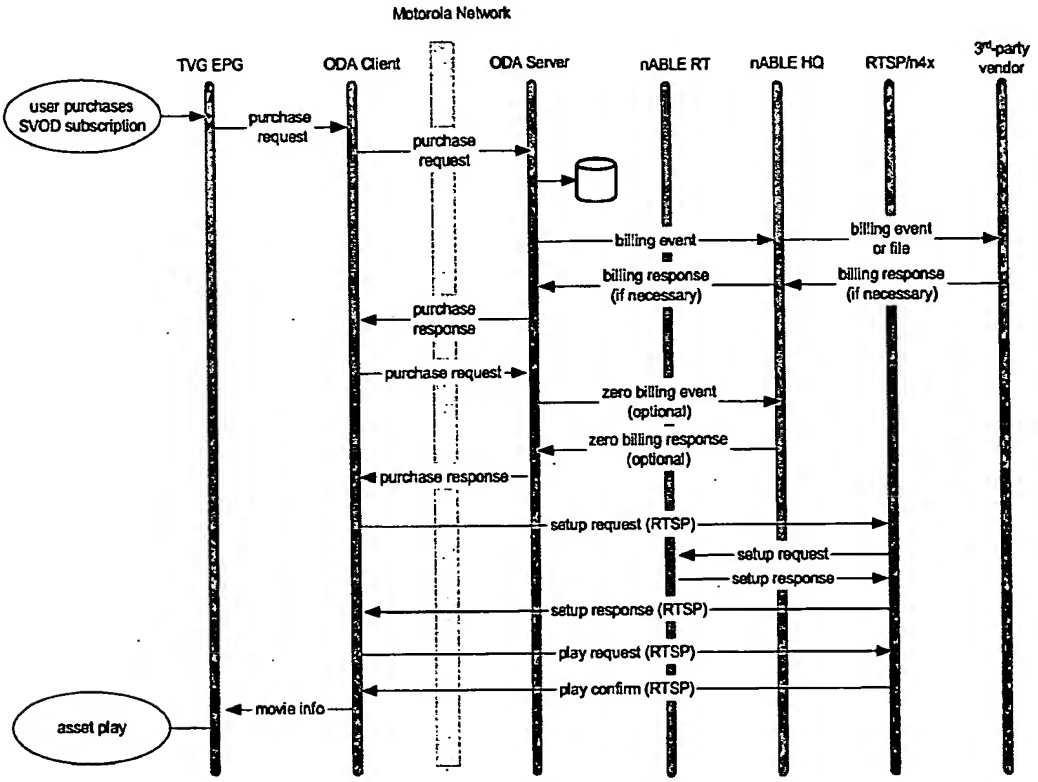
When the viewer has not yet purchased the SVOD subscription, the purchase and session setup for viewing an SVOD asset happen in one up-sell procedure.

Trigger	Event	IB/ OOB	Type	Notes
User selects title from SVOD category.	TVG EPG compares its list of SVOD entitlement IDs against the ID of the package to which this asset belongs. If no match is found, EPG displays a Buy button.	n/a	n/a	
User purchases the SVOD subscription.	TVG EPG issues a purchase request to the ODA client.	n/a	n/a	
	ODA client sends purchase request to the ODA server.	OOB	UDP	
	ODA server sends the billing message via XML over TCP to nABLE HQ.	n/a	TCP	
	If real-time billing, nABLE billing server sends a billing message to billing service. If file-based billing, nABLE HQ outputs the appropriate format: • Vendor-specific file format • Message to vendor billing system • nCUBE XML File Format	n/a	TCP	
	nABLE billing server returns a billing response to the ODA server.	n/a	TCP	
	ODA server returns purchase response to the ODA client, confirming the subscription.	OOB	UDP	
	ODA client sends a purchase request for the selected asset to the ODA server.	OOB	UDP	
	ODA server can send an optional zero billing event to nABLE or not, depending on whether the system is configured to track the viewing of SVOD assets.	n/a	TCP	
	ODA server returns the session information to the ODA client necessary to set up the asset.	OOB	UDP	

Trigger	Event	IB/ OOB	Type	Notes
	ODA client sends a session setup request with the service group ID to the RTSP server.	OOB	RTSP	
	RTSP server assigns a session ID and sends the request to nABLE RT.	n/a	RTSP	
	nABLE RT assigns the Pump ID and Mux ID for the session and sends these to the RTSP server.	n/a	RTSP	
	RTSP server sends the Mux ID and program number to the ODA client.	OOB	RTSP	
	ODA client translates the Mux ID and program number to a VCN, using the cached channel map.	n/a	n/a	
	ODA client submits play command to RTSP server.	OOB	RTSP	
	RTSP server sends confirmation message.	OOB	RTSP	
	Video server begins to stream the session.	IB	MPEG -2	
	ODA client issues the tune request to TV Guide to attempt tuning to the VCN.	n/a	n/a	
	TV Guide issues a tune confirmation to the ODA client, removes the EPG user interface, and shows the program (fail case = error message).	n/a	n/a	MPEG file includes the transport heartbeat, which acts as a keep-alive mechanism during the video stream.

Figure 5-8 shows the process of SVOD up-sell, which happens when an SVOD asset is selected from a subscription that the viewer has not previously purchased.

Figure 5-8: Up-sell to SVOD



Session Setup - Viewing of SVOD Asset

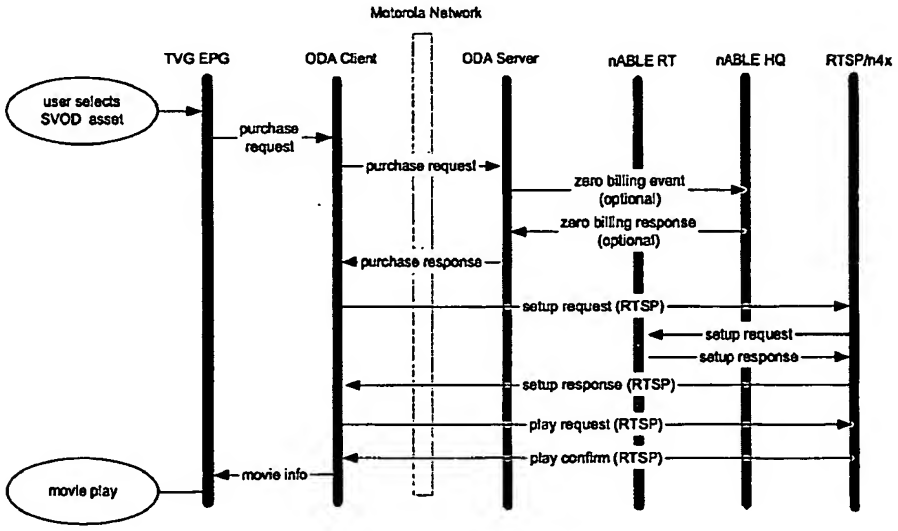
When the viewer has previously purchased the subscription, session setup for viewing an SVOD asset follows this procedure.

Trigger	Event	IB/ OOB	Type	Notes
User browses to SVOD title.	TVG EPG compares its list of SVOD entitlement IDs against the ID of the package to which this asset belongs. If a match is found, EPG displays a Watch button.	n/a	n/a	
User presses Watch.	TVG EPG issues a purchase request to the ODA client.	n/a	n/a	
	ODA client sends a purchase request to the ODA server.	OOB	UDP	
	ODA server can send an optional zero billing event to nABLE or not, depending on whether the system is configured to track the viewing of SVOD assets.	n/a	TCP	
	ODA server returns the session information to the ODA client necessary to set up the program.	OOB	UDP	
	ODA client sends a session setup request with the service group ID to the RTSP server.	OOB	RTSP	
	RTSP server assigns a session ID and sends the request to nABLE RT.	n/a	RTSP	
	nABLE RT assigns the Pump ID and Mux ID for the session and sends these to the RTSP server.	n/a	RTSP	
	RTSP server sends the Mux ID and program number to the ODA client.	OOB	RTSP	
	ODA client translates the Mux ID and program number to a VCN, using the cached channel map.	n/a	n/a	
	ODA client submits play command to RTSP server.	OOB	RTSP	
	RTSP server sends confirmation message.	OOB	RTSP	

Trigger	Event	IB/ OOB	Type	Notes
	Video server begins to stream the session.	IB	MPEG -2	
	ODA client issues the tune request to TV Guide to attempt tuning to the VCN.	n/a	n/a	
	TV Guide issues a tune confirmation to the ODA client, removes the EPG user interface, and shows the program (fail case = error message).	n/a	n/a	MPEG file includes the transport heartbeat, which acts as a keep-alive mechanism during the video stream.

Figure 5-9 shows the process of setting up a session to view an SVOD asset in a subscription that the viewer has already purchased.

Figure 5-9: Session Setup for SVOD Viewing

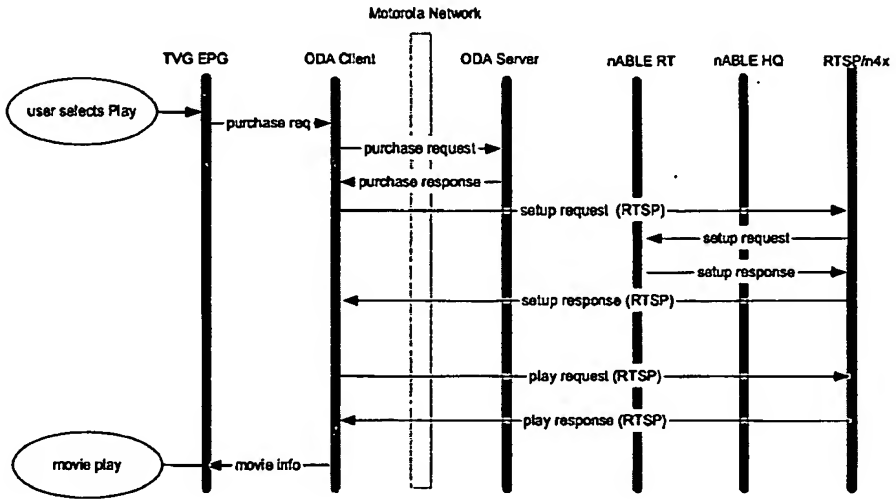


Session Setup - Restart/Resume Playing a Checked-out Asset

Trigger	Event	IB/ OOB	Type	Notes
User selects a checked-out TVOD title or a previously viewed title in an SVOD subscription.	TVG EPG notifies the ODA client of a purchase request to restart or resume a program.	n/a	n/a	
	ODA client sends a purchase request to restart or resume a program to the ODA server.	OOB	UDP	
	ODA server handles the purchase request and returns a purchase response that includes .mpi file location information.	OOB	UDP	
	ODA client sends a session setup request to the RTSP server. (The request includes program start position information that the client cached at session teardown.)	OOB	RTSP	
	RTSP server assigns a Session ID and requests a session with nABLE RT.	n/a	RTSP	
	nABLE RT assigns an output ID to the session including Mux ID, program number, and server topology information, and passes Mux ID and program number to the RTSP server.	n/a	RTSP	
	RTSP server sends RTSP session setup response with session ID and Mux ID to the ODA client.	OOB	RTSP	
	ODA client translates the Mux ID and program number to a VCN, using the cached channel map.	n/a	n/a	
	ODA client submits play command to RTSP server.	OOB	RTSP	
	RTSP server sends confirmation message.	OOB	RTSP	

Trigger	Event	IB/ OOB	Type	Notes
	Video server begins to stream the session.	IB	MPEG -2	
	ODA client attempts to tune to the VCN and notifies TV Guide to begin the session.	n/a	n/a	
	TV Guide client removes the EPG user interface and shows the program (fail case = error message).	n/a	n/a	MPEG file includes the transport heartbeat, which acts as a keep-alive mechanism during the video stream.

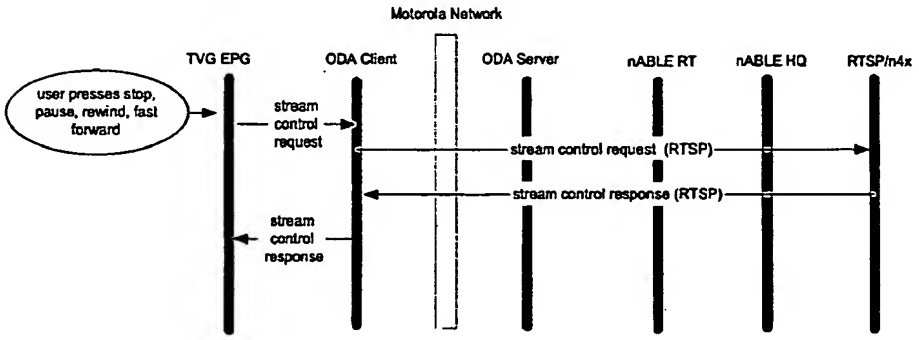
Figure 5-10: Session Setup - Resume Playing a Checked-out Title



Stream Control Operation

Trigger	Event	IB/ OOB	Type
User selects stop, pause, rewind, or fast forward.	TVG client sends a stream control request to the ODA client.	n/a	n/a
	ODA client sends stream control request to RTSP server.	OOB	RTSP
	RTSP server sends stream control response to ODA client.	OOB	RTSP
	ODA client sends stream control response to TVG client.	n/a	n/a

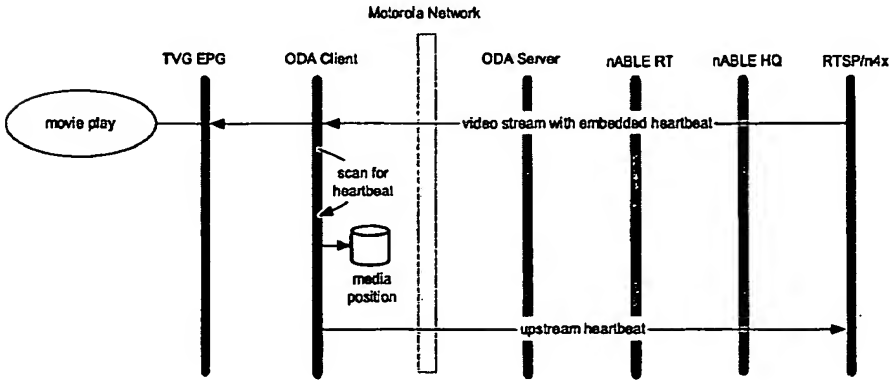
Figure 5-11: Stream Control Operation



Transport Heartbeat

Trigger	Event	IB/ OOB	Type
User begins viewing program.	n4x video server streams an MPEG file with embedded transport heartbeat.	IB	DC2TEXT
	ODA client scans for heartbeat.	n/a	n/a
	ODA client extracts media position from heartbeat message and caches it.	n/a	n/a
	ODA client sends upstream heartbeat to video server.	OOB	UDP
	Video server scans for heartbeat and continues streaming MPEG file.	OOB	UDP

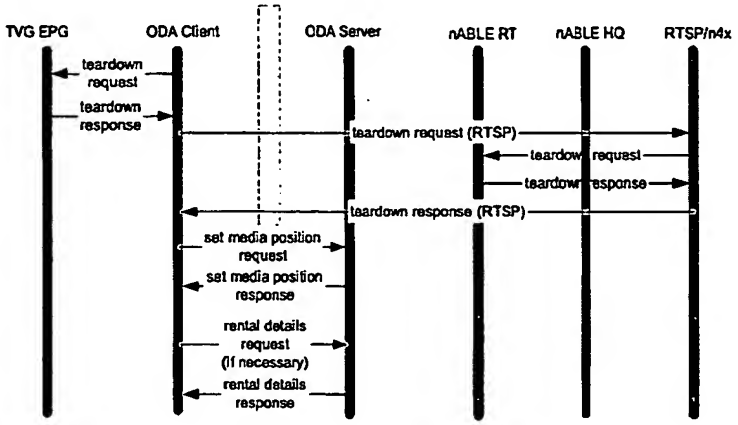
Figure 5-12: Downstream and Upstream Heartbeat



Session Teardown

Trigger	Event	IB/ OOB	Type
End-of-stream reached, pause limit reached, or user selects stop on the remote control.	In the case of end-of-stream or pause limit reached, the ODA client application asks TV Guide to end the session. TV Guide displays the EPG user interface to the user. In the case of user selecting stop on the remote control, TV Guide requests session teardown from ODA client and displays the EPG user interface to the user.	n/a	n/a
	ODA client sends session teardown request to RTSP server.	OOB	RTSP
	RTSP server sends session teardown request to nABLE RT.	n/a	RTSP
	nABLE RT deallocates bandwidth and sends session teardown response to RTSP server.	n/a	RTSP
	RTSP server sends session teardown response to ODA client.	OOB	RTSP
	ODA client sends the set media position request to the ODA server.	OOB	UDP
	ODA server sends media position response to the ODA client.	OOB	UDP
	If the first screen of My Rentals in the next session will display assets for which rental details do not exist on the set-top box, the ODA client sends a rental details request for those assets.	OOB	UDP
	ODA server returns a rental details response with details for the specified assets.	OOB	UDP

Figure 5-13: Session Teardown

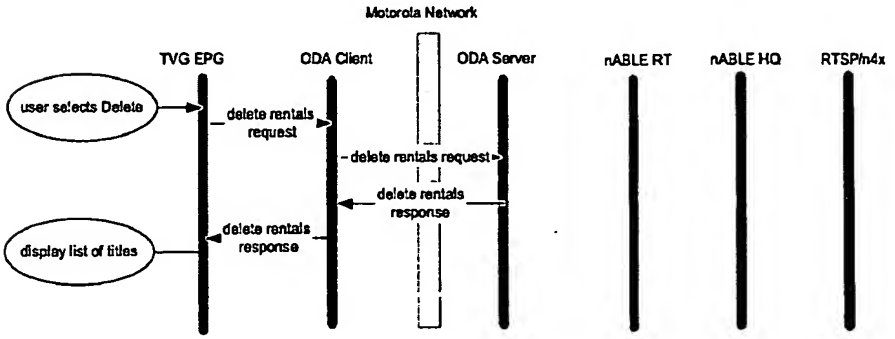


Note: If the subscriber selects Stop, the teardown request from the ODA client to TV Guide, as shown in Figure 5-13, does not happen. Instead, the initial request comes from TV Guide to the ODA client.

Deleting a TVOD Asset

Trigger	Event	IB/ OOB	Type
User selects delete.	ODA client sends a delete rentals request to the ODA server.	OOB	UDP
	ODA server deletes the asset record from the database.	n/a	n/a
	ODA server returns a delete rentals response to the ODA client.	OOB	UDP
	ODA client deletes the asset record from the cached list of bookmarks and deletes the asset's rental details. Then ODA client hands the current screen of rental data to TV Guide.	n/a	n/a
	TV Guide displays the modified list of titles to the user.	n/a	n/a

Figure 5-14: TVOD Asset Deletion Operation



Note: The user cannot delete an asset in an SVOD subscription, except by calling the cable company to cancel the entire subscription.

Chapter 6: nODA 2.3 DCT Error Codes

This chapter describes the error codes that appear on the set-top box.

Error Code	Error Description	Possible Causes	Comments
E101	DCT failed to open a socket to the NC1500.	• DCT not interactive. • DCT not provisioned correctly in DAC. • DCT has no IP address. • NC1500 is down/misconfig. • Interactive network power problem (OOB). • Interactive RPD/Demod not working.	1. Too many in-house splitters? 2. Check Interactivity, IP, and NC1500. 3. Check Diag 10 for interactive status. 4. Check Diag 12 for DCT code status. 5. Cold-init DCT. 6. Replace DCT. Configurable error string is appended to this error.
E102	DCT failed to tune the initialization carousel.	• Wrong channel map, DAC settings. • Edge modulator(s) not sending. • Edge modulator power problem. • Video server not sending service group ID streams. • Misconfigured/down GigE switch.	First time DCT tunes IB data on VOD narrow-cast QAMs 1. System wide? Check edge modulators, video server, GigE switch. 2. Localized? Check narrow-cast SG power level on that node, channel map, DCT-DAC settings. Configurable error string is appended to this error.
E103	Unable to acquire rental.	• DCT memory exhausted.	1. Cold-init DCT. 2. Replace DCT. 3. Call nCUBE Technical Support. Configurable error string is appended to this error.
E104	Unable to acquire rental.	• Server-side problem, sending rental entry multiple times.	1. Call nCUBE Technical Support.

Error Code	Error Description	Possible Causes	Comments
E105 E106	nCUBE DCT (client) code malfunction.	• Bad code on DCT. • DCT memory exhausted.	1. Cold-init DCT. 2. Replace DCT. 3. Call nCUBE Technical Support.
E107 E108	Can not tune and/or obtain movie metadata carousel(s). Primarily this failure occurs while tuning the home channel.	• ODA server down. • Edge modulator(s) down. • GigE switch problem. • Edge modulator power problem. • Video server down. • nABLE server down. • Wrong channel map.	First time DCT tunes data on broadcast QAM 1. System wide? Check video server, edge modulators, switch, channel map. 2. Localized? Check power levels on that node.
E109	nCUBE DCT (client) code malfunction.	• Bad code on DCT. • DCT memory exhausted.	1. Cold-init DCT. 2. Replace DCT. 3. Call nCUBE Technical Support.
E110	DCT client could not parse a number categories response or did not receive one.		1. Call nCUBE Technical Support.
E111	OOB/IB returned number categories failure.		1. Call nCUBE Technical Support.
E112 E113 E114	Can not tune and/or obtain movie metadata carousel(s). Primarily this failure occurs while tuning the home channel.	• ODA server down. • Edge modulator(s) down. • GigE switch problem. • Edge modulator power problem. • Video server down. • nABLE server down. • Wrong channel map.	First time DCT tunes data on broadcast QAM 1. System wide? Check video server, edge modulators, switch, channel map. 2. Localized? Check power levels on that node. Configurable error string is appended to E113.
E115 E116	Out-of-band call for My Rentals list failed.	• ODA server down. • Interactivity down. • Intermittent OOB power problem.	1. Call nCUBE Technical Support.

Error Code	Error Description	Possible Causes	Comments
E117 E118 E119	System was up, DCT obtained one/more genres, then metadata carousels abruptly stopped streaming.	• Metadata carousels went away (right in the middle of surfing genre carousels). • Video server and/or edge modulators went down. • Memory allocation errors. • RF, channel map problem.	1. Persistent? Power cycle DCT. 2. Cold-init DCT. 3. Call nCUBE Technical Support. Configurable error string is appended to E118.
E120-E123	Do not exist in this release.		
E124	Internal communication error between TVG/EPG and nCUBE client code.	• Internal DCT error.	1. Power cycle DCT. 2. Cold-init DCT. 3. Replace DCT.
E125	UDP-IP communication error with ODA server.	• ODA server problem. • Intermittent interactive network problem.	Typically, UDP-connectivity errors occur only on startup. 1. Check NC1500. 2. Check ODA server route. 3. Call nCUBE Technical Support. Configurable error string is appended to this error.
E126	VOD purchase failure.	• STB is not provisioned on nCUBE system. • Billing server not running. • Reached max asset limits for household. • Bad/missing content.	1. Call nCUBE Technical Support. Configurable error string is appended to this error.
E127	Purchase failed because asset does not exist or path to asset is bad.	• ODA server-side error condition, not expected by DCT client.	1. If persistent and/or system-wide, call nCUBE Technical Support.

Error Code	Error Description	Possible Causes	Comments
E128	Side effect of VOD purchase failure.	• Content is bad, or path to content is wrong. • ODA server returns null or inappropriate string after purchase request. • IP connection with the video server failed.	1. Check metadata to ensure content exists in the expected location. 2. Verify file is tagged. 3. Ping the video server. 4. Check that the initialization carousel has the correct IP address. 5. Call nCUBE Technical Support. Configurable error string is appended to this error.
E129	DCT-VOD purchase string received from ODA server when none was expected.	• DCT and ODA server out of sync.	1. If persistent, initialize DCT. 2. If system-wide, call nCUBE Technical Support.
E130	DCT failed to get VCN for tuning after setup.	• ODA server down • Interactive network down and/or intermittent	1. Call nCUBE Technical Support. Configurable error string is appended to this error.
E131	Unreadable ODA server response, or no response received.	• ODA server down. • ODA server malfunction.	1. Check ODA server. 2. If persists, power-cycle DCT, try again. 3. Call nCUBE Technical Support. Configurable error string is appended to this error.
E132	Failed to request to tune.		1. Call nCUBE Technical Support. Configurable error string is appended to this error.

Error Code	Error Description	Possible Causes	Comments
E133	Failed to tune requested channel.	• Channel map problem • Edge modulators are down • Foundry switch problem • Low edge modulator power • Combining problem • Misconfigured ODA server	This is the second time the DCT tunes the narrow cast VOD QAMs. 1. Verify edge modulator, edge modulator power, channel map 2. System wide? Check video server systems 3. Localized? Power level, edge modulator, cmap, DCT 4. Call nCUBE Technical Support. Configurable error string is appended to this error.
E134	Internal client error that occurs when attempting to tune.	• VOD client code on the DCT is out of sync with EPG.	1. Power cycle DCT. 2. Cold-initialize DCT. 3. Replace DCT.
E135 E136	After purchase, DCT must receive embedded control packets in the video. If not received, the stream is torn down by the client.	• Video unexpectedly stopped streaming before end of asset. • Tagging operation failed (bad content). • Edge modulator/downstream problem.	1. Check IB narrow-cast QAMs. 2. Check video server logs. 3. Check that content has transport heartbeat. 4. Try operation again. Configurable error string is appended to these errors.
E137 E138	nCUBE DCT (client) code malfunction.	• Internal error on DCT.	1. Power cycle DCT. 2. Warm-init DCT. 3. Cold-init DCT. 4. Replace DCT.
E139	Problem communicating with RTSP server via interactive network after purchase or during purchase request.	• Interactive network problem – most likely cause. • RTSP server problem. • Video server problem.	1. If this is only box with problem, power-cycle and/or re-init DCT. 2. If all DCTs experiencing this problem, call nCUBE Technical Support. Configurable error string is appended to this error.

Error Code	Error Description	Possible Causes	Comments
E140	Failed to send setup message to RTSP.	• Interactive network problem. • RTSP server problem. • Video server problem.	1. Call nCUBE Technical Support. Configurable error string is appended to this error.
E141	Failed to send play message to RTSP.	• Interactive network problem. • RTSP server problem. • Video server problem.	1. Call nCUBE Technical Support. Configurable error string is appended to this error.
E142	Failed to send VCR command to RTSP, or command was not recognized.	• Interactive network problem . • RTSP server problem. • Video server problem.	1. Call nCUBE Technical Support.
E143	Failed to send VCR command, because sequence number is bad. Very unlikely event.	• TVG maintains internal counter for VOD operations. Error only occurs if counters 'roll over' – they handle billions of ops.	1. Power cycle DCT. 2. Warm-init DCT. 3. Cold-init DCT. 4. Replace DCT.
E144	Problem communicating with RTSP server after or during purchase.	• Interactive network problem. • RTSP server problem. • Video server problem.	1. Call nCUBE Technical Support. Configurable error string is appended to this error.
E145	Session setup failed. Problem communicating with RTSP server after or during purchase.	• The system is out of bandwidth because all streams for the service group are currently in use. • The system is out of bandwidth because some wires have their wire prioritization set to pass. • Many other causes.	1. Try again in 5 minutes. 2. If persistent or system-wide, call nCUBE Technical Support. Configurable error string is appended to this error.
E146 E147 E148 E149 E150	Problem communicating with RTSP server via interactive network after purchase or during purchase request.	• Interactive network problem – most likely cause. • RTSP server problem. • Video server problem.	1. If this is only box with problem, power-cycle and/or re-init DCT. 2. If all DCTs experiencing this problem, call nCUBE Technical Support.

Error Code	Error Description	Possible Causes	Comments
E151	Video bandwidth request not granted	• Out of video bandwidth (QAMs already full). • If unexpected, nABLE operation or config problem. • May be problem with a specific piece of content.	1. Try again in 5 minutes. 2. If unexpected, call nCUBE Technical Support. 3. Check encoded bitrate of content if specific to one asset. Configurable error string is appended to this error.
E152	Received unsolicited VCR command.	• Malfunctioning client.	1. Power cycle DCT. 2. Cold-init DCT. 3. Replace DCT.
E153	Received unsolicited RTSP response.	• Malfunctioning client.	1. Power cycle DCT. 2. Cold-init DCT. 3. Replace DCT.
E154	Metadata version change occurred. This state (not error) occurs while user surfing titles AND metadata version change.	• May occur if VOD system is rebooted.	1. Try operation again in 30 seconds. 2. If persistent, power cycle DCT.
E155	Out-of-band call for GetRentalBookmarks failed.	• Haven't added a route to the STB through the NC 1500. • ODA server down. • Interactivity down. • Intermittent OOB power problem.	TVG/EPG attempts to obtain information for upcoming 'My Rentals' screen, but DCT either did not send the out-of-band (UDP) call or did not receive any data via the OOB response. 1. Check the NC 1500 routing. 2. Check for possible interactive network problem. Configurable error string is appended to E155.
E156	Out-of-band call for GetRentalDetails failed.		
E157	Rental Manager failed to acquire focus.		1. Call nCUBE Technical Support.
E158	Failed to delete rental.		1. Call nCUBE Technical Support.
E159	Failed to read Service Component.		1. Call nCUBE Technical Support. Configurable error string is appended to this error.

Error Code	Error Description	Possible Causes	Comments
E160-E200	Do not exist in this release.		
E201	VOD purchase failed.	• STB is not provisioned on nCUBE system. • Billing server not running. • Reached max asset limits for household. • Bad/missing content. • ODA server returns null or inappropriate string after purchase request. • VCN data in initialization carousel is wrong. • Cache is corrupt. • Channel map problem. • GigE switch problem. • Low edge modulator power. • Combining problem. • Misconfigured ODA server. • Interactive network problem. • Video server problem.	1. Localized to one piece of content? Check asset. 2. Localized to one STB? Check household account information and ODA server client provisioning. 3. If persists, power-cycle and/or re-init DCT, try again. 4. Verify edge modulator, edge modulator power, channel map. 5. System wide? Check video server systems. 6. If persistent and/or system-wide, call nCUBE Technical Support. Configurable error string is appended to this error.

Glossary

The Glossary is where to turn when you have questions regarding the meaning of a term or its usage. This glossary includes terminology related to the cable industry, telecommunications, video on demand.

A

ADC (Analog-to-digital conversion)
An electronic process in which a continuously variable (analog) signal is changed, without altering its essential content, into a multi-level (digital) signal.

ADSL (Asymmetrical Digital Subscriber Line)
A technology for bidirectional digital transmission on standard twisted-pair copper phone lines used for consumer TV applications with "VCR-like" quality.

Analog Video
A non-digital video signal used by most conventional video equipment for input or output. Video in which all the information representing images is in a continuous-scale electrical signal for both amplitude and time. Three basic analog video formats exist: NTSC, PAL and SECAM. (See separate entries for more detailed information.)

API
The specific language and message format used by an application program to communicate with an operating system or another application program such as a database management system (DBMS) or communications protocol.

Artifact
In video systems, something distorted or unintended observed in the reproduction of an image by the system. Flaws in a picture, such as cross-color artifacts, cross-luminance artifacts, jitter, blocking, ghosts, etc.

Asset
In a VOD system, when a cable operator enters metadata information into a database about a movie. Typically done through an application such as nABLE.

Asynchronous
Processes that proceed independently of each other until one process needs to "interrupt" the other process with a request. Using the client-server model, the server handles many asynchronous requests from its many clients. The client is often able to proceed with other work or must wait on the service requested from the server.

Asynchronous Transfer Mode (ATM)
High-speed, packet-switched and multiplexed switching technique for the efficient transmission of voice, data and video. Transmission format uses packets of a fixed length of 53 bytes. A peak throughput of 155 Mbps or 622 Mbps is available for OC-3 and OC-13 installations, respectively.

B

Back Channel
Communications link used by the client to send video stream control commands (such as fast forward or play) to the server.

Bandwidth
Communications capacity of a specific path or transmission line through a network, measured in bits per second (bps). Refers to the frequency range transmitted by an analog system. In video systems, specifying the highest frequency value is sufficient, since all video systems must transmit frequencies down to 30 Hz or lower.

Baseband
Bandwidth characteristic of networks occupied by a single digital signal, such as Ethernet or Token Ring LANs.

Baud
The prevalent measure for data transmission speed until replaced by a more accurate term, bps (bits per second). One baud is one electronic state change per second. Since a single state change can involve more than a single bit of data, the bps unit of measurement has replaced it as a better expression of data transmission speed.

Bit
The smallest unit of information in a computer. A bit has a single binary value, either 0 or 1.

Bit Assignment
In video compression, the process of creating the compressed data bit stream from the raw output of the compression algorithm.

Blocking
An artifact of visible discontinuities between adjacent blocks in a DCT-based compression. Often seen at high compressions.

Broadband
The sharing of multiple signals over the same bandwidth, accomplished simultaneously through the use of multiplexing (splitting) of the signal.

Broadband File System (BFS)
A Scientific Atlanta data carousel for sending information to set-top boxes.

Buffer
A data area shared by hardware devices or program processes that operate at different speeds or with different sets of priorities. The buffer allows each device or process to operate without being held up by the other.

Bursty Traffic
Data transmission with low duty cycle; data in multiple periods of short duration.

C

Cable Modem
A device connected to or integrated in a PC that enables you to receive and request information from the Internet over your local cable TV line. Cable modems provide

throughput of up to 27 Mbps with about 2.5 Mbps of bandwidth for interactive responses in the other direction. This bandwidth far exceeds that of the prevalent 14.4 and 28.8 Kbps modems and the up to 128 Kbps of ISDNs or even the much higher speeds (up to 8 Mbps) of ADSL telephone technology.

Carrier

1. A signal that carries modulation; 2. A provider of data carrying services.

Cell

A fixed-size packet of data, for example that found in ATM.

Client

Application running on a VOD customer's set-top box (STB) that communicates with a video server.

Client-Server

Distribution of computing responsibility between front-end and back-end programs. When multiple machines are used, a client-server architecture supports reduced network traffic and increased overall performance.

Clip

Additional video added to a movie such as commercials, trailers or previews.

Coaxial and Fiber-Optic Cable

A coax can provide 100 channels, each of which is effectively a 36 Mbps pipe. These can be broken down further into 12 x 3 Mbps MPEG-2 digital television channels thus giving a total of 1200 channels (plus spare capacity for control and management) as opposed to one on a twisted pair. (There are many variations on this calculation, but all indicate an enormous number of channels.) Likewise a fiber-optic cable can provide up to 150,000 times the capacity of a twisted pair.

Codec

1. In communications engineering, the term codec is used in reference to integrated circuits, or chips that perform data conversion. In this context, the term is an acronym for "coder/decoder." This type of codec combines analog-to-digital conversion and digital-to-analog conversion functions in a single chip. In personal and business computing applications, the most common use for such a device is in a modem.

2. The term codec is also an acronym that stands for "compression/decompression." A codec is an algorithm, or specialized computer program, that reduces the number of bytes consumed by large files and programs.

Coding

The process of representing a varying function as a series of digital numbers.

Compression

The translation of audio, digital data or video into a more compact form for storage and transmission. Computer algorithms and techniques such as ETSI, G.722, JPEG or MPEG enable data content compression. A digital process that allows data to be stored or transmitted using less than the normal number of bits. Video compression refers to techniques that reduce the number of bits required to store or transmit images.

Container

Data package, found in SDH, which floats with respect to the payload area of STM frames.

Contract Entity
The supplier with whom the contract is negotiated.

Contract Term
The contract may last for a number of years and may be renewed. It must have a start and end date.

Content
Any form of source material: movies, games, news, images, sounds, etc. which will appear on the user's television or PC screen.

D

Dark Fiber
A fiber optic line without terminal equipment provided the operator, and without switching.

Decoding
The process of converting coded data into its original format.

Digital
Describes electronic technology that generates, stores and processes data in terms of two states: positive and non-positive. Positive is expressed or represented by the number 1 and non-positive by the number 0. Thus, data transmitted or stored with digital technology is expressed as a string of 0s and 1s. Each of these state digits is referred to as a bit and a string of bits that a computer can address individually as a group is a byte.

Digital Video
Video where all of the information representing images has been digitized, allowing it to be more flexible and rapidly manipulated or displayed by a computer.

DVB-ASI (Digital Video Broadcast-Asynchronous Serial Interface)
Output format used in the cable industry.

DTA (Digital Turnaround)
Digital turnaround (DTA) systems make it possible to place insertions directly into an incoming MPEG-2 encoded program in the digital domain without first decoding to baseband. A DTA system joins, or splices, broadcast events encoded at the broadcast origination point with locally encoded ads or content. (DiviCom)

DVB (Digital Video Broadcasting)
The European group that works on digital TV broadcasting standards based on MPEG. The group has more than 110 members and has issued standards for digital TV broadcasting on cable and satellite.

Digitizing
The process of converting an analog signal into a digital representation. With images, it refers to the processes of scanning and analog-to-digital conversion.

E

Encoding

The process of converting analog electronic signals into digital format for storage, manipulation and display by a computer. Audio capture boards, scanners, video frame grabbers, or a combination of these devises carry out content encoding.

Ethernet

The most widely installed local area network technology. Now specified in a standard, IEEE 802.3, Ethernet was originally developed by Xerox and then developed further by Xerox, DEC and Intel. An Ethernet LAN typically uses coaxial cable or special grades of twisted pair wires. The most commonly installed Ethernet systems are called 10BASE-T and provide transmission speeds up to 10 Mbps. Devices are connected to the cable and compete for access using a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol.

F

Fast Ethernet

Also called 100BASE-T10 provides transmission speeds up to 100 megabits per second and is typically used for LAN backbone systems, supporting workstations with 10BASE-T cards. Gigabit Ethernet provides an even higher level of backbone support at 1000 megabits per second (1 gigabit or 1 billion bits per second).

FDDI (Fiber Distributed-Data Interface)

A standard for data transmission on fiber optic lines in a LAN that can extend in range up to 200 km (124 miles). The FDDI protocol is based on the token ring protocol. In addition to being large geographically, an FDDI LAN can support thousands of users.

Fiber Channel

A technology for transmitting data between computer devices at a data rate of up to 1 Gbps (one billion bits per second).

Field

One of the two scans of a frame in interlaced scanning formats.

Flat Fee

The licensee pays an arranged amount to the supplier to make the title available to the subscribers for a given time period, regardless of the number of times the title is purchased.

Frame

1. A single image in video or film. PAL and SECAM use 25 frames per second to create the image and simulate motion, whereas NTSC uses 30 frames per second (fps); 2. A group of data bits organized according to a specified format. Considered a logical entity with control information for use in bit-oriented protocols; 3. The result of a complete scan of one image. In motion video, the image is scanned repeatedly, making a series of frames. Typical video frames comprise two interlaced field of either 525 lines (NTSC) or 625 lines (PAL/SECAM), and running either at 30 frames per second (fps) or 25 fps. Motion picture film runs at 24 fps.

Frame Grabber

A device that captures and stores one complete video frame.

Frame Rate
Measured in frames per second (fps), frame rate indicates the speed of frame display impressions on a monitor. Standard broadcast TV frame rates equal 30 fps in North America and 25 fps in Europe. Most Internet video streaming facilities offer a frame rate of 15 fps.

Frame Relay
Frame relay is a technology for transmitting data packets in high-speed bursts across a digital network encapsulated in a transmission unit called a frame.

Full Motion Video
Video displays shown at the broadcast frame rate of 30 fps for NTSC-original signals or 25 fps for PAL-original signals.

G

GAS
Guaranteed Addressable Subscribers

GBR
Guaranteed Minimum Buy Rate. A proportion of the subscriber base by box office category. It can be fixed or variable.

Genlocking
The process of synchronization to another video signal. It is required in computer capture of video to synchronize the digitizing process with the scanning parameters of the video signal.

Genre
The category that defines a movie, such as Action, Drama or Comedy.

Gbit/s (gigabits per second)
A digital transmission speed of billions of bits per second.

Gbps (gigabits per second or billions of bits)
A measure of bandwidth on a digital data transmission medium such as optical fiber.

Gigabit Ethernet
A local area network (LAN) transmission standard that provides a data rate of 1 billion bits per second (one gigabit). Gigabit Ethernet is defined in the IEEE 802.3 standard and the first product versions of it are now available. Gigabit Ethernet is used as an enterprise backbone.

Gigabit LAN
A term for the increasing of the data transmission speed of a conventional LAN to nearly 1 billion bits per second. Efforts are underway to boost Ethernet and AnyNet types of LAN to the gigabit range.

Gigabyte
The measure of memory capacity that is "roughly" a billion bytes. A gigabyte is two to the 30th power, or 1,073,741,824 in decimal notation.

GME
Guaranteed Minimum Exposure.

GUI
A Graphical User Interface to an information system.

H

Headend
A cable company site, typically an unattended building that contains all the cable equipment needed to send cable signals to viewers' homes. The headend is where programming is aggregated and combined onto HFC for distribution to cable hubs.

HDTV
High-definition television; the idea of improved spatial resolution with an improved temporal resolution, improved color rendition, fewer artifacts, a wider aspect ratio, and multi-channel sound. Common name for several proposed standards for improved image quality.

HFC (Hybrid Fiber Coax)
A type of network that contains both fiber-optic cables and copper-coaxial cables. The fiber-optic cables carry TV signals from the headend office to the neighborhood; the signals are then converted to electrical signals and go to houses on coaxial cables.

High Bit Rate
Data streams of 1.5 Mbps or greater, providing 30 frames per second of full-motion video delivery (comparable to broadcast television quality).

Hz (Hertz)
A unit of electromagnetic frequency (of change in state or cycle in alternating current) of one cycle per second. Hertz (Hz) replaces the earlier term of "cycle per second (cps)." One kilohertz (kHz) is equal to 1,000 cycles per second.

Hypercube
2 or more nCUBE n4x video servers connected together. Provides scalability to a system.

I

I-Frame
The MPEG compressed video frame where redundancy between adjacent frames is not taken into account, only the information in a single frame is compressed. It is used in conjunction with the B (bidirectional) and P (predictive) frame encoding. If frames are lost during MPEG decoding, the decoder cannot fully recover until the next I frame comes along. The frequency of I frames in a sequence determines how long it takes to get a reasonable picture after a random access or loss of data.

Image
A still picture, or one frame of a motion sequence.

Image File
A file of data that represents an image.

Image Plane
Each memory array in digital video display hardware that has more than one video memory array contributing to the displayed image in real time.

Interactive TV
Enables viewers to interact with the television set in ways other than simply controlling the channel and the volume and handling videotapes. Typical interactive TV uses are selecting a video film to view from a central bank of films, playing games, voting or providing other immediate feedback through the television connection, banking from home and shopping from home.

Interactive Video
The fusion of video and computer technology. It denotes a video program and a computer jointly operated under the user's control. The interactive choices the viewer makes influence the manner in which the program unfolds.

Interactive Video Module (IVM)
The combination of a CPU card and NICs.

Interactivity
The ability of a user (or a computer) to control the presentation by a multimedia system, not only for material selection, but for the way in which material is presented.

Interframe Coding
Video coding that examines differences between frames.

Interlaced Scanning
The concept of splitting a TV picture into two fields of odd and even lines.

Intraframe Coding
Video coding within a frame of a video signal.

Inverse Multiplexing
The splitting of one (broadband) data stream into a number of independent data streams with lower bit rates and the subsequent combination of these separate circuits into one data stream.

ISDN (Integrated Services Digital Network)
A CCITT digital telecommunications standard developed to transmit high-bandwidth digital data, voice and video signals. Bearer channel (ISDN B) provides circuit-switched bandwidth in multiplex of 64 Kbps, while a 16 Kbps packet-switched data channel (ISDN d) is also available. Common interface packages include Basic Rate Interface (BRI), consisting of two 64 Kbps B channels and one D channel, and Primary Rate Interface (PRI), consisting of 24 channels, usually composed of 23 B channels and a single D channel.

ISO (International Organization for Standardization)
Founded in 1946, the leading international standards organization. Among its developed standards is Open Systems Interconnection (OSI), a suite of communication protocols used widely in Europe.

Isochronous
(From the Greek "equal" and "time"; pronounced "eye-SAH-krun-us") Signal delivery capability at a specified rate, suitable for continuous data such as full-motion video and voice. Pertains to processes that require timing coordination to be successful, such as voice and digital video transmission. A sound or picture going from a peripheral computer device or across a network into a computer or television set needs to arrive at close to the same rate of data flow as the source. In feeding digital image data from a

peripheral device (such as a video camera) to a display mechanism within a computer, isochronous data transfer ensures that data flows continuously and at a steady rate in close timing with the ability of the display mechanism to receive and display the image data.

J

Jitter
Unwanted frequency or phase variations, such as rate variations of a data stream or phase noise of a carrier signal. Also called **Phase Jitter**.

JPEG
Abbreviation for "Joint Photographic Experts Group," a working party of the ISO-IEC Joint Technical Committee 1, working on algorithm standardization for compression of still images.

K

K (Kilo)
In general usage, K represents 1,000. In the context of computer systems, however, K usually represents 1,024, so 64K is actually 65,536.

Kb (Kilobit)
1,024 bits. Also kb.

KB (kilobyte)
1,024 bytes. Approximately equivalent to half a sheet of paper's worth of typing, double-spaced.

Kbit/s (kilobit per second)
A digital transmission speed of thousands of bits per second.

Kbps (kilobits per second)
In the United States, Kbps stands for thousands of bits per second and is a measure of bandwidth (the amount of information that can flow in a given time) on a data transmission medium such as twisted-pair copper cable or coaxial cable.

Kernel
The essential center of a computer operating system, the core that provides basic services for all other parts of the operating system. Typically, a kernel (or any comparable center of an operating system) includes an interrupt handler that handles all requests or completed I/O operations that compete for the kernel's services, a scheduler that determines which programs share the kernel's processing time in what order, and a supervisor that actually gives use of the computer to each process when it is scheduled. A kernel also may include a manager of the operating system's address spaces in memory or storage, sharing these among all components and other users of the kernel's services. A kernel's services are requested by other parts of the operating system or by applications through a specified set of program interfaces known as system calls.

Keying
In a video system, the process of inserting one picture into another picture under spatial control of another signal, called keying the signal.

L

Logical Content
Logical groupings in a database of movies + clips + content. Movie is stored in one place but can have different clips associated with it to form different logical content.

Licensors Share
Percentage of the actual sale price to the subscriber that is due to the licensor.

M

MDS
Media Data Store. Special storage area for video content on the nCUBE video server. Controlled by nVS. Accessed through nCUBE Server Manager or special "mds" UNIX commands.

MediaHUB
Trademarked term for a single nCUBE video server, which includes the motherboard, Havoc board, various I/O boards and hard disks. "Hub" is the generic term often used for MediaHUB.

Minimum Wholesale Price
The minimum price that the licensee can charge the subscriber for the VOD event.

MPEG
A standard way of compressing analog video into digital form. Consists of I-frames, B-frames and P-frames.

N

nVS
nCUBE Video Server. Software on the nCUBE video server that pumps video to clients.

P

P-Frame
Used in MPEG compression, a predictive algorithm calculates P-frames taking into account information that is common among adjacent frames. The P-frame predicts the difference between the current frame and the closest preceding I- or P-frame. P-frame is used with I- and B-frame encoding.

Packet
A packet is the unit of data that is routed between an origin and a destination on any packet-switched network. Files are broken into packets for ease of transmission.

Package
Subscription- or promotional-based container for one or more products. See Subscription Package and Promotional Package.

Packetized Data
Data such as that representing video that is segmented into small pieces that are, for example, wrapped, labeled, numbered, addressed, error protected so as to survive transit

through a heterogeneous or hostile environment; the small pieces are reassembled on completion of their journey.

PAL

Acronym for "Phase Alteration Line," which is the key feature of the color television system developed in West Germany and used by many other countries in Europe. This system is called the PAL system and uses an interlaced 625-line, 25-frames per second picture, except PAL-M (only in Brazil), which uses an interlaced 525-line 30-frames per second picture.

PALplus

An enhancement of PAL that provides 16:9 aspect ratio and improved picture quality (reduced cross-color and cross-luminance artifacts). A PALplus signal is shown in a letterbox format on a normal PAL TV set.

Payload

The actual message, audio data, etc., in a data stream excluding control signals, error checking and other overhead information.

PDU (Protocol Data Unit)

A unit of information (e.g., packet or frame) exchanged between peer layers in a network.

Phase Alteration Line (PAL)

Analog video format standard that features a vertical frequency of 50 Hz, used in most of Western Europe, Australia, and parts of Asia and Latin America.

Pixel

A single point of an image, having a single pixel value.

Pixel Operation

The process of modifying a pixel value for some specific purpose.

Pixellation

In a digital image, a subjective impairment where the pixels are large enough to become individually visible.

Plug-in

A software module that is application-specific and is used in conjunction with another software package.

Point of Presence (POP)

A facility used by a network access provider to house physical equipment that enables subscribers to access the network. The term is used to describe the location where a long-distance service provider connects to a local service provider, and also the location where a service operator houses equipment that enables subscribers to access interactive services.

Post-Production

In video and audio, the process of merging original video and audio from tape or film into a finished program; Post-production includes editing, special effects, dubbing, titling and many other video and audio techniques.

PPV

Pay-per-View. The concept of programming services that are paid for individually.

Predictive Coding
The coding of each pixel by quantizing the difference between its current value and predicted value, computed from past values.

Product
A container for a title

Production
In video, refers to the process of creating programs. In more specific usage, production is the process of getting original video onto tape or film, ready for post-production.

Promotional Package
Package with a short-term availability. Consumer pays a one-time fee to have access to the content for the availability period.

Protocol
Set of syntax rules defining exchange of data including items such as timing, format, sequencing, error checking, etc.

Q

QoS (Quality of Service)
The idea that transmission rates, error rates, and other characteristics can be measured, improved, and, to some extent, guaranteed in advance. QoS is of particular concern for the continuous transmission of high-bandwidth video and multimedia information. Transmitting this kind of content dependably is difficult in public networks using ordinary "best effort" protocols.

Quantization Levels
The predetermined levels at which an analog signal can be sampled as determined by the resolution of the analog-to-digital converter (in bits per sample) or the number of bits stored for the sampled signal.

Quantizing
The process of converting the voltage level of a signal into digital data after the signal has been sampled.

R

RAID (Redundant Array of Independent Disks)
RAIDs can be hardware or software. The nCUBE video server uses a software RAID (level 4) in which content is striped across disks on independent SCSI buses so any individual disk failure does not affect the streaming of video. By placing data on multiple disks, I/O operations can overlap in a balanced way, improving access performance. Since multiple disks increases the mean time between failure (MTBF), storing data redundantly increases fault-tolerance.

Random-Access
In digital memory or mass storage, the ability to access any point or address without any limitation.

Real-Time Feed
A live event, such as a boxing match, where the content is encoded and streamed to the customer on the fly.

Registering or Tagging
Process by which a movie is scanned to create I-Frames to enable trick play. This creates an MPI file. Movies do not play on the nCUBE video server without this file!

Remote Control and Navigation System
Users need a friendly interface to find their way through all the services offered and communicate their requirements to the central Control System.

Repeater
A device that regenerates, re-times, and amplifies electrical signals.

Resolution
Measurement of display image quality in terms of the number of pixels available.

Return Path
In a fully interactive system, there needs to be a signal going from the user to the Control System carrying the user's requests.

Revenue Share
A percentage of the actual price charged to the subscriber (exclusive of taxes) due to the licensor.

Router
A device that sends messages by the best route, especially over large networks.

RSVP
A host protocol used to request a specific quality of service (QoS) from the network to support an application data stream. RSVP generally enables the reservation of resources along a data path, with built-in interoperability for current and future unicast and multicast routing protocols.

RTSP
Real Time Streaming Protocol. A communication protocol between a client and a video server.

S

S-Video
A type of video signal used in the Hi-8 and S-VHS videotape formats. S-video transmits luminance and color portions separately, using multiple wires. In so doing, S-video avoids the NTSC encoding process and the inevitable loss of picture quality that results from it.

Sample
A representative value of a signal at a chosen instant, derived from a portion of that signal.

Sampling
The process of finding the instantaneous voltage of signal at a specific moment or repetitively at a given rate (the sampling rate).

Satellite
A wireless, one-way broadcast medium providing no possibility of a Return Path (other than telephone).

Scalability
The capacity for a computer application or product (hardware or software) to continue to function well as it (or its context) is rescaled (typically, to a larger size). The nCUBE video server architecture allows for you to increase the number of hubs on your system, thus increasing the number of output streams as needed.

Scalable Video
Refers to video compression that can handle a range of bandwidths, scaling smoothly over them.

SDH
Synchronous Digital Hierarchy; a set of telephone standards that enable synchronous multiplexing of data streams on high-speed links.

Server-based video
Refers to video that is streamed from a video server software package.

Set-top Box (STB)
A device that converts digitally compressed video input signals; an addressable communications box is needed to decode the signals as they arrive at the television; depending on the system used it also may need to perform functions such as the decompression of the digital signal, or the handling of the Return Path.

SNMP (Simple Network Management Protocol)
An Internet standard protocol, designed for the management of nodes residing on an IP network.

SONET
Synchronous Optical Network; a set of American standards equivalent to SDH. SONET provides standards for a number of line rates up to the maximum line rate of 9.953 gigabits per second (Gbps). Actual line rates approaching 20 gigabits per second are possible. SONET is considered to be the foundation for the physical layer of the broadband ISDN (BISDN).

Spatial Resolution
The number of pixels horizontally and vertically in a digital image.

STM (Synchronous Transfer Mode/Synchronous Transport Module)
In ATM, a method of communications that transmits data streams synchronized to a common clock signal (reference clock).

Storage Hierarchy & Control System
Even compressed videos require enormous amounts of storage space; the control system must be able to service all the requests coming in.

Streaming
The real-time transfer of data. The file is downloaded in pieces and is viewed as it is downloaded, thus producing a "stream" of data.

Streaming Media

Multimedia content - such as video, audio, text, or animation - that is displayed by a client as it is received from a broadcast network.

Subscription Package

Package with an availability period of one month or longer. For example, a children's package that is available from month to month. Consumer pays a monthly fee for access to the content of the package for the month.

SVGA (super video graphics array standard)

This system can support a palette of up to 16,000,000 colors, although the amount of video memory in a particular computer might limit the actual number of displayed colors to something less than that. Image-resolution specifications vary. In general, the larger the diagonal screen measure of an SVGA monitor, the more pixels it can display horizontally and vertically. Small SVGA monitors (14-inch diagonal) usually display 800 pixels horizontally by 600 pixels vertically. The largest monitors (20 inches or more diagonal measure) can display 1280 x 1024, or even 1600 x 1200, pixels.

Synchronous

Data communication that requires that each end of an exchange of communication respond in turn without initiating a new communication. A typical activity that might use a synchronous protocol would be a transmission of files from one point to another. As each transmission is received, a response is returned indicating success or the need to re-send. Each successive transmission of data requires a response to the previous transmission before a new one can be initiated.

T

T-carrier system

The first successful system that supported digitized voice transmission. The original transmission rate (1.544 Mbps) in the T-1 line is in common use today in Internet service provider (ISP) connections to the Internet as well as corporations. Another level, the T-3 line, providing 44.736 Mbps, is also commonly used.

TCP/IP

Transmission Control Protocol/Internet Protocol; The Internet's most common transmission protocol, and can broadly be described as the first-language of the Internet. IP (Internet Protocol) is simply the method for forming and then routing "packets" of data; TCP (Transmission Control Protocol) adds three critical functions:

- **Packet Sequencing**: TCP gives each "packet" of data a number, so that all packets are properly reassembled at the receiver.
- **Reliability**: TCP ensures that all "packets" of data sent off actually arrive by requesting retransmission of the packets if they get lost.
- **Flow Control**: When the Internet becomes clogged, all travelling data is expected to retreat somewhat to allow fair use of the available space. TCP allows the data to do this.

Telco

Slang for telephone company, the provider of telephone services. Often the local supplier rather than the long-distance supplier.

Temporal R solution
The ability of the display to reproduce adequate detail to allow the visual system to distinguish the separate parts or components of an object that is moving through the display.

Terabyte
A measure of memory capacity that is two to the 40th power or "roughly" (as a decimal number) a thousand billion bytes (that is, a thousand gigabytes).

Time Code
A system of identifying frames recorded on videotape by assigning each frame a chronological number based on a 24-hour clock.

Token Ring Network
A token ring network is a type of local area network. In a token ring network, all workstations are connected in a ring or star topology and a token-passing scheme is used to prevent the collision between two workstations who want to send messages at the same time.

Transit
Operating system on the nCUBE video server.

Transmission System
High speed links are required to deliver the vast amounts of information in a timely manner.

Tributary
One of several data streams being multiplexed into an aggregate data stream.

Trick Play
The ability to do VCR remote-like functions including fast forward, rewind and pause. VOD systems usually allow trick play. I-Frames in VOD allow this capability.

Trunk
The communications line between two points or switching systems; mostly the connection between two major switching centers.

Twisted Pair
The most common existing wired system as it is present in millions of telephone lines going to houses, but also the most limited in its bandwidth.

U

UDP
User Datagram Protocol; A communications transport protocol layer that is an alternative to the Transmission Control Protocol (TCP) layer. Like TCP, it interfaces with the Internet Protocol (IP) layer. UDP, however, does not provide the data gathering reliability of TCP. For example, it does not provide sequencing of the packets in which the data arrives. This means that the application program must be able to provide these services.

Universal Network

The idea of a single network that integrates the existing voice and public telecommunications network (including the Internet), cable TV, data networks, and video broadcast networks so that they work together well.

V

VBR (Variable Bit Rate)

A form of data delivery where bits are grouped irregularly and vary with time. Compression that can be delivered at a variable bit rate can adapt to changing network bandwidths as well as to changing properties of a video, such as the amount of motion.

Video on Demand

Video that can be requested at any time and is available at the discretion of the end user.

W

Wire

A logical connection between a physical connector of a board to a group of clients (a service area). The wire can be used to model bandwidth limitations and possible connections, while a node, board, and connector model physically available hardware.

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